Candling, Sizing, Packing, and Materials-Handling Equipment and Methods Used in Egg Assembly Plants

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PREFACE

The basic study for this report is part of a larger research project covering the development of principles for planning improved layouts and designs for certain kinds of marketing facilities at various stages in marketing channels. It also covers the proper location, size in relation to volume, and methods of operating marketing facilities.

The project is under the general supervision of William H. Elliott, staff assistant for marketing facility and materials-handling research, Marketing and Facilities Research Branch, Production and Marketing Administration, and is being financed from Marketing Service appropriations. A second report is planned to develop and present improved layouts and designs for egg assembly plants. It was necessary first to study the operations performed in such plants as well as the methods, including equipment, used.

In the study, the Production and Marketing Administration had the assistance and cooperation of L. Z. Eggleton and Frank J. Wollney, Iowa State College of Agriculture and Mechanic Arts; William H. Dankers and Cora E. Cooke, Department of Agriculture, University of Minnesota; Gerald E. Zich, New Jersey State Department of Agriculture, Division of Markets; Ralph L. Baker, School of Agriculture, Pennsylvania State College; Floyd Z. Beanblossom, Texas Agricultural and Mechanical College; and William P. Mortenson, College of Agriculture and Agricultural Experiment Station, University of Wisconsin. They helped to select the egg assembly plants studied in their respective States and made many valuable suggestions.

Information and assistance were provided by the manufacturers of the various types of equipment described in this report, especially by John W. Cox, Ray Stone, and Edward Fahey, Self-Locking Carton Company; Fred Haller, Robert Gair Company; J. M. Devers, A. H. Campbell, and M. J. Peterson, Food Machinery and Chemical Corporation; and Walter J. Reading and James A. Seybert, Barker Poultry Equipment Co. They also supplied photographs and layouts of candling and packing equipment.

Special credit is due also to Frederick C. Winter, Assistant professor of industrial engineering, Columbia University, and consulting engineer, Marketing and Facilities Research Branch, and Joseph F. Herrick, Jr., agricultural economist; and credit is due Catherine A. Perry, Clayton F. Brasington, Jr., Stuart D. Gilchrist, and Frederic L. Faber.

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SUMMARY

The wide variety of conditions under which eggs are produced and the consequent patterns of production that have developed, together with the location of producing areas in relation to consuming centers, are reflected in the types of equipment and facilities used in egg assembly plants. Some facilities, in concentrated producing areas, have become highly integrated and conduct all marketing functions between the producer and the retailer. However, most eggs are handled by several marketing agencies during the process of assembly and distribution. A majority of the egg assembly plants studied handled between 20,000 and 60,000 cases of eggs annually; several of the plants handled more than 100,000 cases annually.

New and improved methods and equipment for cartoning and candling eggs, on a "production line" basis recently introduced in the industry, are of particular interest to plant operators who seek ways of increasing operational efficiency. Interest is being manifested in the introduction of improved materials-handling methods and equipment. As a first step in meeting the needs of plant managers this report: (1) Describes various egg candling and cartoning systems; (2) presents some of the principles for improving handling methods; and (3) outlines some of the improved materials-handling methods observed in progressive egg assembly plants.

The three basic types of candling systems in use are:

1. Bench systems.
2. Belt systems.
3. Combination systems.

Two types of candling benches are utilized in bench systems. By use of the wall-type candling bench, which is placed against a wall, the candler performs all operations associated with candling, including handling full cases, candling, sizing, cleaning, packing, and sealing. By use of the "pull-push" type candling benches, which usually are placed so as to leave space for the candlers' work stations between the bench and the wall, candlers are supplied cases of eggs from the far side of the bench by a case handler who also removes full cases of candled eggs, seals, and places them in the holding area. Candlers pull cases of uncandled eggs into their respective work stations and push cases of candled eggs out of these stations. Both systems are used principally in plants where eggs are packed in cases (uncartoned).

Six different conveyor-belt candling and cartoning systems were observed in egg assembly plants. These systems introduce production-line techniques and provide for greater specialization on the part of workers:

Belt conveyor system A. This system utilizes the "pull-push" bench and incorporates a conveyor belt, carton setup machine, closer and sealer, and a rotary packing table. Conveyor belts move empty cartons to the candling and cartoning stations and full cartons to the carton-closing machine.

Belt conveyor system B. Candling work stations are provided on both sides of a conveyor belt so that the system can be installed in a relatively short room.

Belt conveyor system C. This system is particularly adapted for relatively short areas which are accessible from only one side. Candling work stations are provided on both sides of a three-level conveyor belt. Cases of eggs are transported by a series of gravity conveyors terminating at roller-ball tables accessible to the work stations.

Belt conveyor system D. The basic difference in this and other systems is the method of supplying uncandled eggs to the candler work stations. A loader removes eggs in flats and fillers from the cases and transfers them to a belt which conveys them to the candlers. This system is limited to lots of eggs for which a grading record is not required since the identity of each filler is lost after it is placed on the conveyor belt. Both sides of a dual belt are utilized for work stations so that the system can be installed in short rooms.

Belt conveyor system E. This system provides a higher degree of candler work specialization than do other belt systems, by reducing the handling of packing materials. Eggs are supplied to candling work stations on both sides of a dual belt operating at the same level. Loose eggs are placed on one belt and then transferred to a second belt which transports the loose eggs to the candlers on the opposite side. The rotary packing table used in the other systems described is not incorporated into this system.

The production-line systems were designed to improve the efficiency of the candling, cartoning, and packing operations. Several manufacturers have incorporated equipment for performing other operations, such as mechanical sizing, washing, tabulating, drying, and oil treating, into the candling production line. Two of the combination systems are:

Belt conveyor system F. In addition to the candling, cartoning, and packing operations performed by use of belt cartoning systems, this system includes an automatic sizer and a tabulator. The handling of cartons by candlers is minimized

by the addition of an overhead catwalk with chutes at each work station for supplying cartons.

Candler, washer, and drier. The problem of washing eggs is minimized by incorporating these operations into a belt conveyor system. This equipment is also designed to include an oil-treating machine if needed.

Observations in a number of egg assembly plants indicated that plant managers and foremen might improve handling operations in their plants through application of the following basic materials-handling principles to the methods of using their present equipment:

1. Balanced handling. Consists of the arrangement and assignment of work crews so as to minimize delay time and reduce total labor requirements.

2. Unit load. Consists of several packages grouped together so that they may be handled as a unit rather than as individual packages.

3. Mechanical equipment. Consists of the introduction of mechanical equipment in place of manpower wherever practicable.

4. Materials flow. The direct movement of eggs and supplies, through the shortest possible distance, in the shortest possible time, with the minimum use of labor.

5. Review of operations. The periodic review of materials-handling methods to insure maximum operating efficiency.

6. Preventive maintenance. The proper care and lubrication of equipment so as to minimize breakdowns and failures.

Many plants fail to provide adequate materials-handling equipment. Frequently, as volumes increase, additional equipment of the type already in use is added. Of the assembly plants studied, 88 percent used two-wheel hand trucks; only 20 percent used skids which permitted the handling of larger unit loads. About 56 percent of all plants also used conveyors of the belt or gravity type in their operations.

A number of plant operators have developed and are using improved handling methods. Some of the methods and equipment which appear to have wide applicability include the following:

1. Modified egg case trucks with suitable attachments permitting the handling of both wooden and fiberboard

egg cases. The attachments not only make possible better use of equipment, but also result in a 33-percent increase in the load carried per trip.

2. Four-wheel hand trucks are used in 32 percent of the egg assembly plants and generally are used in conjunction with conveyors. The use of the four-wheel hand truck, with a unit load of 20 egg cases, provides an efficient means of transporting eggs and related supplies within egg assembly plants. This type of truck is used in conjunction with conveyors in loading and unloading operations where platforms are not of the proper height or are entirely lacking.

3. Dollies of various sizes are used for handling eggs, empty cases, and related supplies in unit loads. They are frequently homemade and inexpensive, and their use in several plants has reduced the cost of handling operations.

4. Skid systems, which utilize either dead or semi-live skids, are found in some of the larger egg assembly plants where the volume of eggs requires considerable handling equipment. These systems utilize the unit-load principle and reduce the individual handling of packages in these plants. Additional savings in labor requirements are possible where the platforms are at truck-bed level so that the equipment can be brought into motortrucks during the loading and unloading operations.

5. Chutes of various types are used very effectively in conveying eggs and packaging materials, by gravity, between the various floor levels of egg assembly plants. They are most commonly used in multistory egg assembly plants for conveying empty cases and supplies from storage areas to production work stations.

6. Gravity conveyors, either of the rigid or flexible type, are used extensively in egg assembly plant operations. They are used most frequently in loading and unloading operations, and they are also incorporated into or used at work stations where continuous operations are conducted. The portability and flexibility of gravity conveyors permit their use for handling operations in many small plants where the amount of materials-handling equipment is limited.

7. Belt conveyors, either of the fixed or portable type, are used effectively in continuous or intermittent handling

operations between different floor levels. They are used widely in the loading and unloading operations at egg assembly plants where platforms are lacking. The fixed type is particularly effective in transporting eggs and related supplies between different floor levels in multistory buildings. The use of belt conveyors permits the efficient use of floor space in basements or upper stories which otherwise would pose a serious handling problem.

In many cases a combination of several types of equipment will best serve the needs of a particular plant. Several methods utilizing four-wheel hand trucks and skids, in conjunction with conveyors, are presented, together with combinations of equipment for handling operations in multistory buildings.

Among the handling aids and innovations observed were the following: (1) An auxiliary movable candling bench; (2) a collapsible stand in the receiving area for spot candling; (3) internal plant communication systems to save steps; (4) a driveway signal for producer deliveries; (5) a mechanical buffer for cleaning eggs; (6) a gummed tape dispenser and a stapler for sealing fiberboard cases; (7) a hammer stapler for lidding wooden cases; (8) an unloading portal for producer deliveries; (9) an auxiliary door with loading portal for overhead doors; (10) a truck-loading portal in the refrigerator; (11) storage racks for empty producer cases; and (12) a measuring stick to determine the loading pattern in motortrucks.

CANDLING, SIZING, PACKING, AND MATERIALS-HANDLING EQUIPMENT AND METHODS USED IN EGG ASSEMBLY PLANTS

By Norman G. Paulhus, agricultural economist
and Frank P. Delle Donne, industrial engineer
Marketing and Facilities Research Branch

INTRODUCTION

Producers sold 52,656 million eggs, having a total sales value of $2,350,884,000, in 1952. More than 59 percent of all eggs produced are marketed through central assembly plants (shippers) and their local buying stations. 1/ This method of marketing requires: Assembling by truck; rehandling and packing at the local buying stations; additional trucking to the central assemblers; further rehandling, candling, and packing; and loading out, usually in large truck trailer loads, for terminal market destinations.

This report, and a second report which is in preparation, will make available to the poultry and egg industry some of the results of research undertaken to evaluate different types of egg-handling equipment and handling methods and to develop principles covering improved layouts for egg assembly plants. Some of the methods and equipment used for receiving, candling, sizing, cleaning, shell-treating, packing, and loading-out operations were observed in 25 egg assembly plants. These observations showed a definite need in existing plants for improving egg-handling methods in order to reduce unnecessary handling, utilize floor space more effectively, and reduce handling costs. Because of the wide interest shown by plant owners and managers in adopting improved methods this publication was designed to describe and evaluate some of the more efficient methods and equipment for candling, sizing, packing, and handling eggs. The second report will cover principles involved in planning egg assembly plant layouts.

Operations conducted in local egg-buying stations and in central assembly plants are of two broad classifications:

1. Materials handling. The moving of any product or material in any direction, by any means, in any plant facility.

2. Production. Occurs when a product or material is changed in its physical or chemical characteristics, is inspected for quality measurement, or is arranged or prepared for another operation.

1/ Marketing Margins and Costs for Poultry and Eggs. E. P. Winter. Bureau of Agr. Econ. U. S. Dept. Agr. Tech. Bul. No. 969. Nov. 1948.

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In egg-handling plants the principal cycles or groups of materials-handling operations are: (1) Receiving incoming producer eggs and supplies; (2) intraplant handling between work stations and storage areas; and (3) loading out truckloads and carloads. These operations are defined as follows:

Receiving is a cycle of operations in which eggs and other materials are unloaded from route or producer trucks, transported from the tailgate of truck to the storage area, and placed in storage.

Intraplant handling is: (1) The movement of uncandled eggs and supplies from stockpiles or storage areas to candling work stations or production operations; and (2) the movement of candled and cartoned eggs from packing work stations to storage areas.

Loading out eggs from packing work stations to storage areas is a cycle of operations in which cases of eggs are removed from temporary or permanent storage areas, transported from the storage area to the loading area, and loaded into a motortruck or refrigerator car.

The major "production operations" are loading, candling, sizing, cartoning, packing, shell treating, carton setup, case makeup, and cleaning. These operations are defined briefly as follows:

Loading is the manual transfer of eggs, either in flats and fillers or by use of "three-dozen" transfer trays, onto conveyors at candling work stations.

Candling is a manual-visual operation in which eggs are placed one at a time before a suitable candling light in an attempt to visualize the amount of thick and thin albumen, presence or absence of spots in the albumen or in the yolk, roundness or flatness of the yolk, the condition of the shell, and the size and stability of the air cell. Defective eggs are removed from the lot and the others are separated into various grades. 2/

2/ Interior egg-quality specifications for the Official Standards for Quality of Individual Shell Eggs are based on the use of a candling light delivering approximately 350 to 450 foot-candles of light at the candling opening. United States Standards for Quality of Individual Shell Eggs. U. S. Dept. Agr.

Sizing is the manual or mechanical sorting of eggs by weight and the physical separation of eggs into specific size groups.

Cartoning is the manual placing of eggs in 1-dozen cartons. This operation can be integrated with candling operations or conducted separately.

Packing is the manual placing of either loose eggs in flats and fillers or cartoned eggs into master containers--either the 15- or 30-dozen case--and nailing, stapling, or sealing the case.

Shell treating consists of dipping eggs in a bath of colorless, odorless, and tasteless mineral oil.

Cleaning is the removal of dirt and foreign matter from the egg shell by use of abrasives or by washing. It can be performed either manually or mechanically.

Carton setup is the manual or mechanical preparation or setting up of cartons, which are manufactured flat and folded, for egg-cartoning operations.

Case makeup is the assembly, nailing, or taping of wooden or fiberboard materials into 15- or 30-dozen egg cases.

The handling of package material definitely is a materials-handling problem in egg assembly plants. The term "package material" includes egg cartons, 15- and 30-dozen cases, fillers and flats, sealing tape, and 30-pound liquid egg tin cans. Generally, individual egg cartons are 11 5/8 inches long, 3 7/8 inches wide, and 2 9/16 inches high. Slight variations in these dimensions are found in cartons designed for small and jumbo eggs. 3/ Since requirements differ for domestic and export egg cases, considerable variation exists in dimensions of cases and in types of lumber and fiberboard used. Outside dimensions of a regular (domestic) veneer case are 25 7/8 inches long, 12 1/8 inches wide, and 13 3/8 inches deep. Minimum inside dimensions of 15-dozen fiber cases and for each compartment of a 30-dozen fiber case are 11 3/4 inches long, 11 3/4 inches wide, and 13 inches deep. A regular (chicken) egg filler is 11 1/2 by 11 1/2 inches and 2 5/16 inches deep. A regular (chicken) egg flat is 11 7/16 by 11 7/16 inches.

3/ Recommended Specifications for Standard Packages and Packs for Shell Eggs. Poultry Branch. PMA. U. S. Dept. Agr. Aug. 1950.

No attempt was made to cover all methods and types of equipment available for performing handling and production operations. The equipment and methods described cover some of those studied in selected plants. Other methods and types of equipment equally as efficient as those described may be available. Moreover, equipment in the process of experimental development at the time this study was made undoubtedly will be available in the near future.

Because of the trend toward candling and cartoning eggs in assembly plants, this report emphasizes various systems used for performing these operations. In addition, some of the more outstanding candling benches used in packing eggs loose in cases are described. The wide differences in buying practices (buying on grade, sampling, ungraded) make it necessary for the individual plant operator to determine which candling system best meets his requirements. The candling equipment layouts shown should serve as a guide to plant operators in determining which system could be installed within the physical limitations of existing plants, and in planning new facilities, where needed, to accommodate the system selected.

Observations of handling operations in egg assembly plants indicated that the plant operators in many instances have not been too alert in introducing improved handling equipment and methods. Of the plants studied, 88 percent used two-wheel hand trucks for all or part of their handling operations; only 20 percent used skids and jacks. About 56 percent of these plants also used gravity or belt-type conveyors in their operations. This type of equipment is used to move eggs and other materials from upper stories or basements, and at plants where platforms are lacking to load and unload trucks. In connection with the selection of equipment, plant operators should analyze their facilities, product flow, and handling methods in order to develop a system to minimize the number of handlings and reduce costs. A knowledge of materials-handling principles should prove helpful in analyzing plant handling problems and in providing solutions for improving existing systems or in developing entirely new methods.

Since detailed studies, which would provide data on labor and equipment requirements, were not undertaken, no attempt is made in this publication to compare the efficiency of different types or combinations of types of equipment for specific operations. It is the purpose of this report to describe in sufficient detail some of the more progressive methods used under specified plant conditions. The equipment and methods described should enable interested plant operators to make better use of present equipment and to introduce new types of equipment which would increase the efficiency of various operations. Observations showed that considerable improvement could be made in handling methods without additional equipment costs, by balancing handling crews and by integrating and combining present

Belt conveyor system A. This system utilizes the "pull-push" bench and incorporates a conveyor belt, carton setup machine, closer and sealer, and a rotary packing table. Conveyor belts move empty cartons to the candling and cartoning stations and full cartons to the carton-closing machine.

Belt conveyor system B. Candling work stations are provided on both sides of a conveyor belt so that the system can be installed in a relatively short room.

Belt conveyor system C. This system is particularly adapted for relatively short areas which are accessible from only one side. Candling work stations are provided on both sides of a three-level conveyor belt. Cases of eggs are transported by a series of gravity conveyors terminating at roller-ball tables accessible to the work stations.

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No attempt was made to cover all methods and types of equipment available for performing handling and production operations. The equipment and methods described cover some of those studied in selected plants. Other methods and types of equipment equally as efficient as those described may be available. Moreover, equipment in the process of experimental development at the time this study was made undoubtedly will be available in the near future.

Because of the trend toward candling and cartoning eggs in assembly plants, this report emphasizes various systems used for performing these operations. In addition, some of the more outstanding candling benches used in packing eggs loose in cases are described. The wide differences in buying practices (buying on grade, sampling, ungraded) make it necessary for the individual plant operator to determine which candling system best meets his requirements. The candling equipment layouts shown should serve as a guide to plant operators in determining which system could be installed within the physical limitations of existing plants, and in planning new facilities, where needed, to accommodate the system selected.

Observations of handling operations in egg assembly plants indicated that the plant operators in many instances have not been too alert in introducing improved handling equipment and methods. Of the plants studied, 88 percent used two-wheel hand trucks for all or part of their handling operations; only 20 percent used skids and jacks. About 56 percent of these plants also used gravity or belt-type conveyors in their operations. This type of equipment is used to move eggs and other materials from upper stories or basements, and at plants where platforms are lacking to load and unload trucks. In connection with the selection of equipment, plant operators should analyze their facilities, product flow, and handling methods in order to develop a system to minimize the number of handlings and reduce costs. A knowledge of materials-handling principles should prove helpful in analyzing plant handling problems and in providing solutions for improving existing systems or in developing entirely new methods.

Since detailed studies, which would provide data on labor and equipment requirements, were not undertaken, no attempt is made in this publication to compare the efficiency of different types or combinations of types of equipment for specific operations. It is the purpose of this report to describe in sufficient detail some of the more progressive methods used under specified plant conditions. The equipment and methods described should enable interested plant operators to make better use of present equipment and to introduce new types of equipment which would increase the efficiency of various operations. Observations showed that considerable improvement could be made in handling methods without additional equipment costs, by balancing handling crews and by integrating and combining present

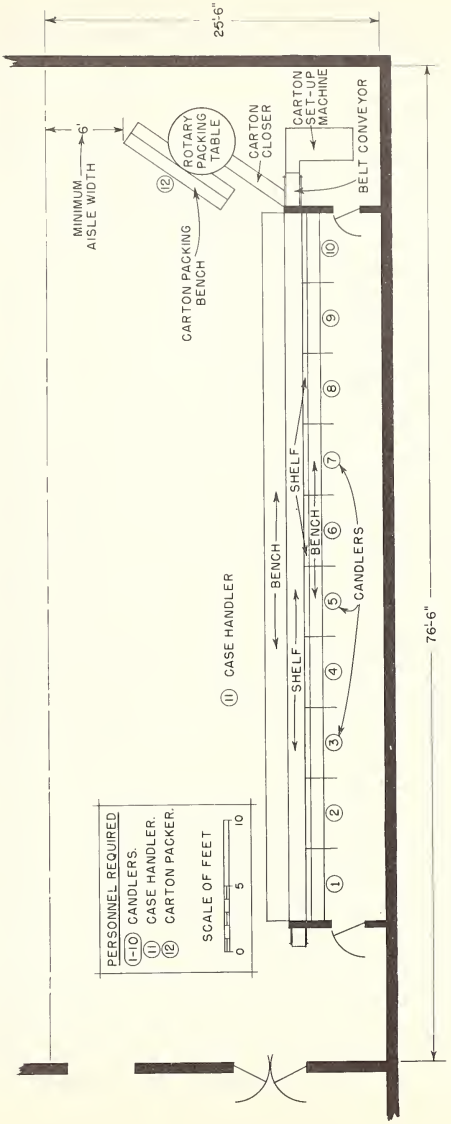

Figure 5.--Layout of belt conveyor system A.

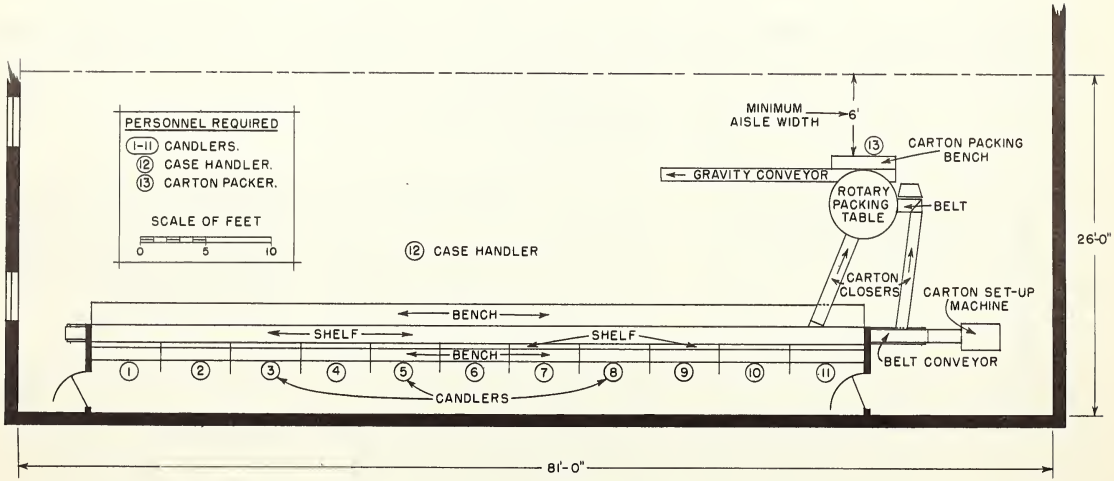

Figure 6.--Layout of belt conveyor system A with two types of carton closers.

It may be noted from the candling room layouts that the carton-packing table and the carton setup and closing machines are separated from the candling area by partitions. The candling area is kept semidark and the packing and handling areas are illuminated either by natural or artificial overhead lights. Artificial lights usually are placed over the work stations as shown in figure 7. This figure also shows the work station arrangement at the carton-packing table (see fig. 5 for the location of this table in relation to the candling and cartoning stations). In figure 7, the carton setup and closing machines are partially concealed by the packer in the foreground. As packed cartons of eggs leave the closing machine, they are deposited on the rotary packing table, which conveys them to the packer who picks up the cartons and packs them in cases. Empty cases, flats, grade stamps, and automatic gummed tape dispensers are within easy reach of the carton packer. The packing bench, which has space for holding either four 15-dozen cases or two 30-dozen cases, accommodates two carton packers when the candling line is operating at full capacity. With this arrangement, the case handler can assist the packer when he is not performing his regular duties.

Another arrangement of this equipment is shown in figure 8. (See fig. 6 for a candling room layout using this equipment arrangement.) This arrangement provides for the handling of two different types of cartons which require different carton closers. One of these closers is to the right of the rotary table and the other is to the left. Closed cartons are deposited at different points on the rotary table. This arrangement may be required when customers demand different kinds of cartons.

Carton manufacturers have engineers who are available to study the needs of individual plants and to install setup machines, closers, and packing tables. Carton markers or gummed tape sealing units also can be added to the carton closers if desired. These units usually are necessary in plants that identify Government-graded eggs or use company code markings.

Belt Conveyor System B

Belt conveyor candling and cartoning system B is similar to system A except that candling work stations are provided on both sides of the bench and conveyor belt (fig. 9). This system can be installed in candling rooms of relatively short lengths in relation to widths since both sides of the belt are utilized for work stations. It is, therefore, adaptable to some plants that do not have adequate space for other types of cartoning systems. This system eliminates the use of the pull-push principle of supplying uncandled eggs to the work stations and removing empty cases, and one of its distinguishing features is a two-level gravity conveyor along one side and running

Figure 7.--Work station at rotary packing table.

Figure 8.--Packing table with two types of carton closers.

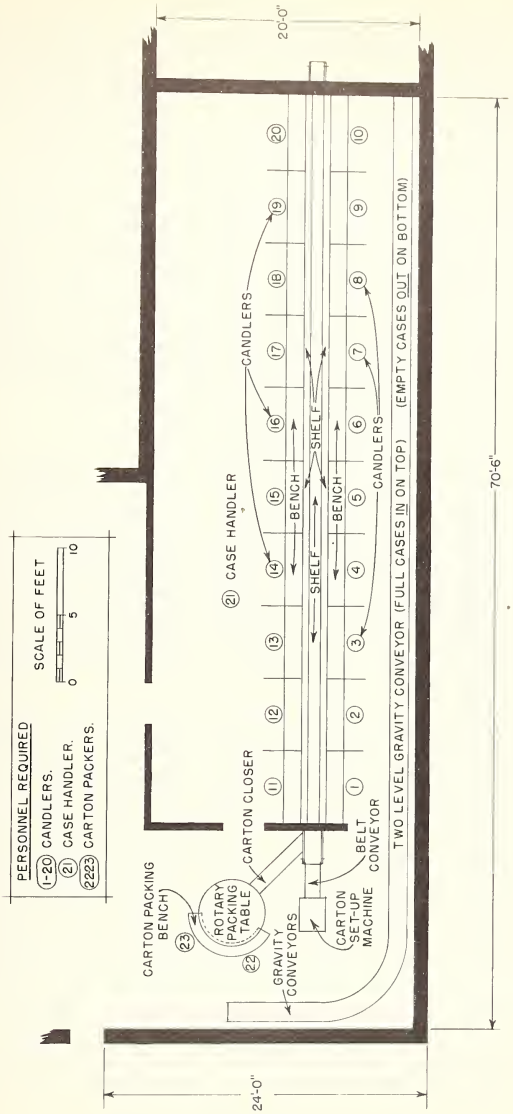

Figure 9.--Layout of belt conveyor system B.

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the full length of the work stations. The top level of this conveyor is used to transport full cases of uncandled eggs to the work stations and the bottom level is used to transport empty cases to the carton-packing bench. The belt conveyor is used in this system for moving empty cartons to the work stations and cartons of eggs from these stations to the closing machine as it is used in system A.

In this system, cases of uncandled eggs are manually lifted by each candler from the gravity conveyor or from a stack to the rear of the candler and placed on the candling bench. The case handler keeps the conveyor and stacks of eggs replenished. Figure 9 shows a layout with 20 work stations, which would require two carton packers when all stations are operating at capacity. Under usual plant operating conditions, one worker can pack cartons of eggs for 10 to 12 candlers. As the number of candlers increases, it is necessary to add another packer. The equipment requirements may be determined by the manufacturer in planning the installation desired.

Belt Conveyor System C

The candling and cartoning system shown in figure 10 is an installation for a company that cartons eggs for its own retail outlets. This system, which is part of a combination poultry-dressing plant and egg assembly station in a concentrated producing area, was adapted to the egg and poultry facilities by some modifications of the equipment and buildings originally purchased. The arrangement of candling and cartoning equipment was determined by the manufacturers so as to provide maximum utilization of floor space and to permit the handling of unit loads by use of skids and industrial low-lift trucks.

As shown in figure 10, the belt conveyor used in system C serves candling work stations on both sides of the belt and bench as in systen B (see fig. 9). The upper belt is used to move empty cartons and other supplies to the stations and the lower belt to carry cartons of eggs to the closing machine. In both systems this arrangement of stations permits a larger number of candlers to be placed in a given length of candling room space. It is also necessary to provide a means of supplying uncandled eggs to one side of the belt conveyor by means of gravity conveyors. In this system the one continuous gravity conveyor to the rear of the candlers used in system B has been replaced by two short lengths or sections of gravity conveyors for each four work stations. The conveyor lines extend from the stations toward the center of the candling room and the upper conveyor sections terminate at a roller ball table accessible to each of the four candlers. The gravity conveyors hold a sufficient number of cases so that candlers always have a supply of uncandled eggs and the case handler can load them periodically. Empty cases are transported away

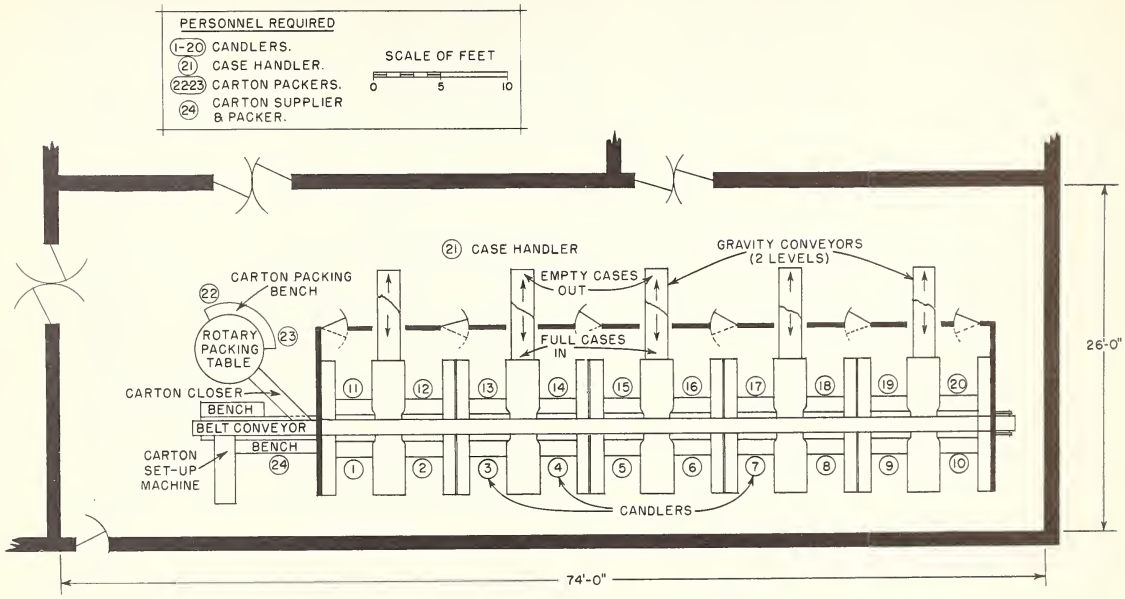

Figure 10.--Layout of belt conveyor system C.

from the work stations on gravity conveyors directly underneath the conveyors used to supply full cases to the candlers.

The layout of the candling work station used in this system is different from those of the systems previously described, in that each station has shelves on both sides which are used for stacking empty cartons, flats, and fillers and for holding cracked eggs, bloody eggs, and other rejects. The shelf area is quite extensive and the combined width of the shelves on both sides of the belt occupies a wider area than was true of the systems described previously.

The work station arrangement shown in figure 10 permits a high degree of work specialization on the part of candlers. Uncandled eggs are moved in unit loads, on skids, from the egg cooler rooms to the gravity conveyor lines. Cases of eggs are then transferred to the upper gravity conveyors, each of which supplies four candling work stations. Both of these operations are performed by the case handler who also removes the empty cases from the lower-level conveyor and stacks them on skids for transporting to the storage area.

Belt Conveyor System D

Candling and cartoning system D provides a greater amount of specialization, particularly at the candler and cartoning work stations, than do the systems previously described. In this system eggs are conveyed to the candling work stations in flats and fillers on a conveyor belt, rather than in cases. Instead of a case handler supplying each work station as in previous systems, this system utilizes one loader at the end of the belt who transfers eggs in flats and fillers from the incoming cases onto the conveyor belt. Eggs are conveyed to each work station and a constant supply is kept in front of each candler by use of an electronic control. This method of supplying eggs to the work stations eliminates the need for the candlers' handling of bulky cases and permits a high degree of specialization in candling and cartoning operations. In addition to the simplification of the candling operation, work stations are designed to permit the candler either to stand or sit, which improves work conditions and helps reduce fatigue.

Because of the higher degree of specialization, the candling and cartoning production rate is materially increased over systems previously described. The capacity of the production line is determined in part by the workers at the loading and packing benches. Usually 12 candlers (6 on each side of the conveyor line) are supplied by one loader (fig. 11). If the plant volume warrants the addition of more than 12 work stations, another line can be added and the packing operation combined on the rotary packing table.

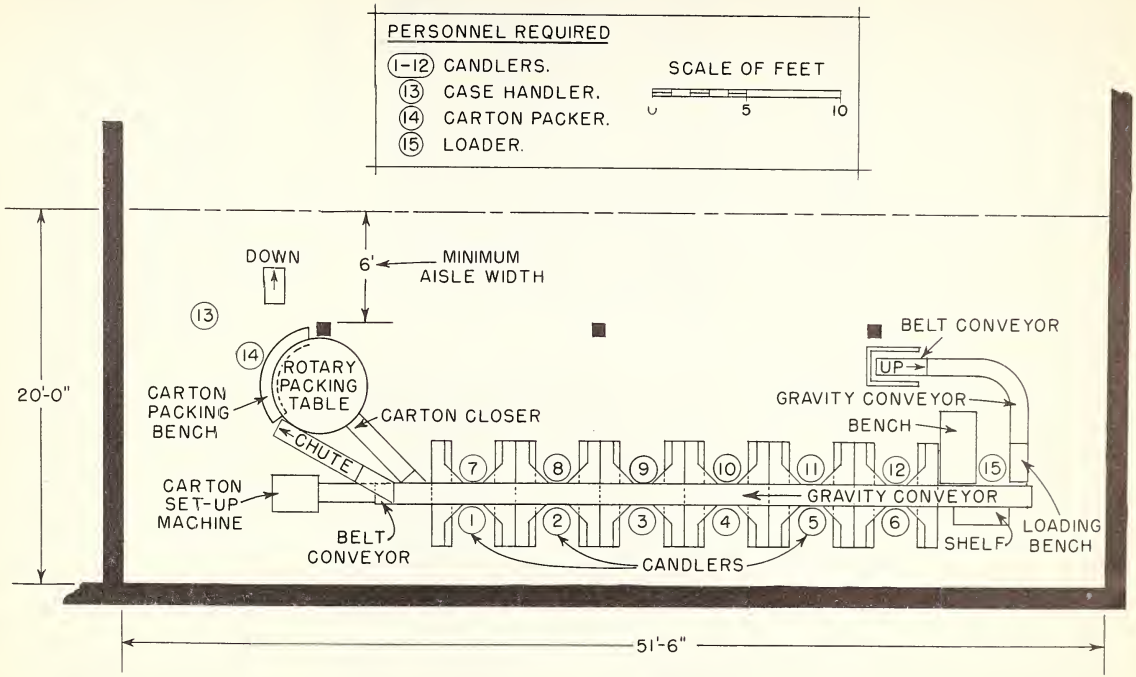

Figure 11.--Layout of belt conveyor system D.

This system utilizes either two or three conveyor belts, depending on plant conditions and the direction of flow desired. In the plant layout shown in figure 11, the system contains two belt conveyors which utilize four different belt levels for conveying cartons and eggs (fig. 12). The lower belt, which extends beyond the upper belt, is so arranged that the loader can place on it the flats of eggs to supply the candlers. The upper line of this belt conveys uncandled eggs to the work stations and the lower line returns undergrade eggs to the loader station for packing in cases. The upper level of the top belt conveyor is used to move empty cartons to each work station. The lower level of this belt removes full cartons of eggs and conveys them to the carton closer and packing area. The empty cases from the loading station are placed on a gravity conveyor mounted over the candling booths and extending to a chute at the packing bench (fig. 13).

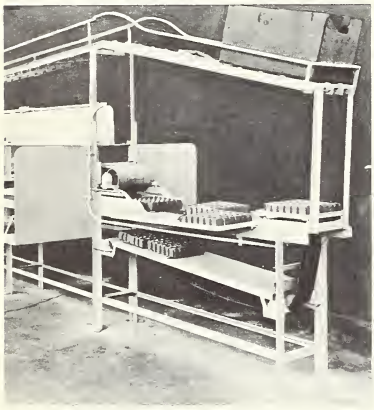

Figure 12.--Loading station showing uncandled eggs in fillers on top conveyor belt, and candled undergrades being returned on lower belt. (Note overhead gravity conveyor, which moves empty cases to packing bench.)

Figure 13.--Gravity conveyor mounted above work stations, to transport empty cases to packing bench.

Because of the method, previously described, for supplying eggs to the candlers under this system, work stations are of a different design from those used in systems A, B, and C. Since the eggs are supplied to the candlers in flats and fillers, only a small tray is required in front of each candler to hold the flat of eggs being candled (fig. 14). Double rows of shelves on each side of the station are provided. The upper shelves

are used for holding empty cartons and flats and the lower shelves for temporarily holding undergrade eggs. Empty fillers are collapsed and placed in a box on the floor to the left of the candler, or they are placed on the lowest belt and carried out of the candling area. Shelf space for additional cartons also is provided in front of the candler.

After eggs are candled and cartoned, the cartons are conveyed to the carton closers and sealers and then to the rotary packing table (fig. 15). As cartons of eggs are pushed onto the conveyor belt at

Figure 14.--Candling work station showing candling tray and shelf arrangement.

Figure 15.--Rotary packing table with closer and sealer (left), chute for empty cases (center), and carton setup machine (right).

the work station they are automatically counted so that it is possible to obtain the production at each work station. They are recounted at the carton closer which permits a recheck on the total production of the entire candling line. As cartons leave the closer they are conveyed by the rotary table to the packer. Empty cases are supplied by a chute which connects with the overhead gravity conveyor line and empties directly at the packers' bench.

In candling systems previously described the case handler supplies eggs to individual candler work stations and also transports candled eggs from the packing table to the holding room or area. By use of this system the case handler transports cases of uncandled eggs from the storage room to the loading station and cases of cartoned eggs from the packing station to the holding area or cooler. The higher degree of specialization, coupled with the improved work stations, increases efficiency and reduces worker fatigue.

Belt Conveyor System E

A distinguishing feature of belt conveyor system E is that loose eggs are moved to the candlers' work stations by use of the belt conveyors. In this system candlers do not handle packaging materials, such as flats and fillers, at their work stations. Figure 16 shows work stations for five candlers and the carton setup and packing area which are a part of this system. It should be noted from this illustration that candlers can work in either a sitting or standing position. Five additional stations are provided on the opposite side of the candling bench.

As shown in figure 17, eggs are emptied from cases one flat at a time by a loader who places each flat on an automatic "stripper" which gently pushes the eggs off the flats onto a lateral belt conveyor. From this station loose eggs are conveyed to the main belt conveyor, which moves the eggs to each of the candling work stations on one side of the bench only and to a transfer station at the end of the belt. When the eggs reach the end of the belt they are transferred to a second belt operating at the same level in the opposite direction. This belt supplies eggs to the five candlers' work stations on the opposite side of the candling work bench.

The arrangement of the individual candling work station is shown in both figures 16 and 18. In the station on the extreme right in figure 16 loose eggs are shown on the lower conveyor belt. The belt just above the lower belt level, or between the lower and upper conveyor lines, conveys full cartons of candled eggs to the carton-closing machine. The upper belt level conveys empty cartons to the work station. The shelves directly in front of and on each side of the candler are conveniently located and are used to hold empty cartons and off-grade and reject eggs. The area of the room occupied by candling work stations is kept semidark; the loading and packing area is well lighted by use of lights shielded by suitable reflectors. This lighting arrangement provides good working conditions for both the packing and candling areas.

Figure 16.--View of five candling work stations along conveyor belt with loader and packing stations in background.

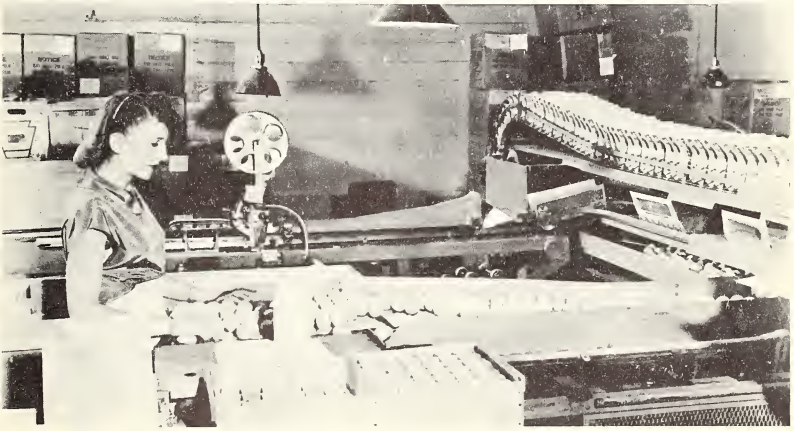

Figure 17.--Loader's station where eggs are gently pushed off flats mechanically and conveyed to the main belt conveyor.

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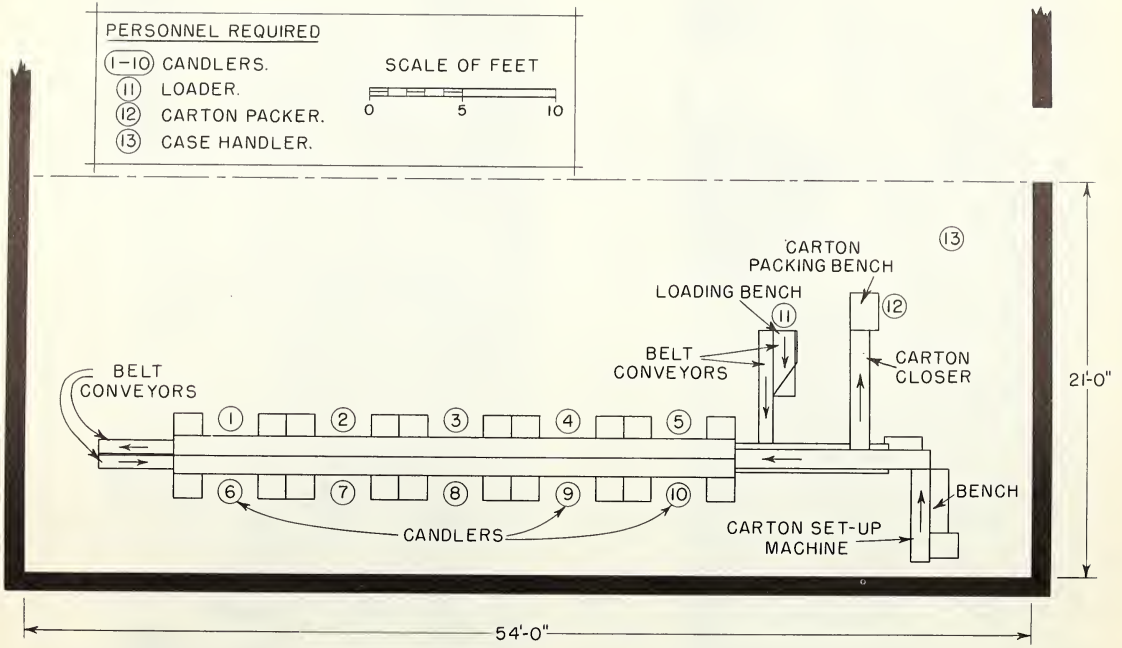

Figure 18.--Layout of belt conveyor system E.

The carton-closing machine shown in figure 19 closes the cover, dates, and seals cartons of eggs and delivers them to the packing bench. The packer sorts the different grades of cartoned eggs and transfers them to the appropriate egg cases. It should be noted that the loading and the packing work stations are located adjacent to each other, which simplifies the work of the case handler who supplies uncandled eggs and removes cartoned eggs to a holding area. In addition to full cases of eggs, necessary packing materials, such as flats, fillers, and empty cases, also are concentrated in this general area. The concentration of eggs and packing materials in this area minimizes handling and transportation time and permits the case handler, on occasion, to assist or substitute for the packer.

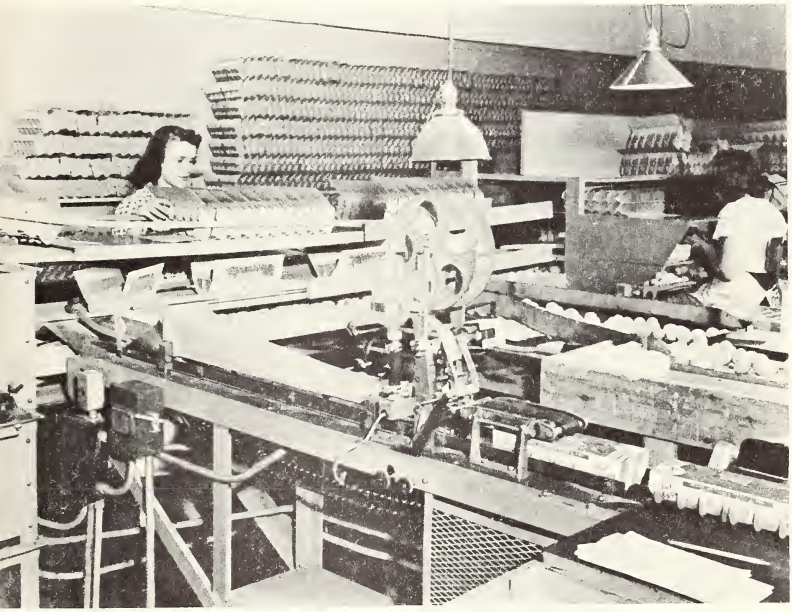

Figure 19.--Carton closing and sealing machine (foreground).

Combination Candling, Sizing, Washing, Tabulating, Drying, and Oiling Systems

The production line systems previously described were designed to improve the efficiency of the candling, cartoning, handling, and associated operations. In recent years several manufacturers have incorporated equipment for performing some operations now performed manually and for performing additional operations, in the candling production line. Although there are several systems of this type, only those observed under actual operating conditions are described. Many egg assembly plants, particularly the larger plants, conduct a number of operations in addition to candling and cartoning. As an example, some plants wash or oil-treat eggs. Some plants mechanically size eggs rather than spot check sizes by use of an egg scale. These operations usually are seasonal or are conducted on a part-time basis. Generally the equipment used for these is in a separate room away from the candling and cartoning room.

Flow process charts made in plants conducting these operations show that sizing and washing is done before candling and oil-treating after candling. In the majority of plants these operations are performed separately from candling-line operations and double handling is necessary if eggs are candled and then sized or oil-treated. To eliminate additional handling and conserve floor space, equipment has been developed that combines and performs several different operations on one machine. Two different systems with equipment of this type were observed. In the first, which is referred to as belt conveyor system F, a sizing machine and a tabulator are incorporated into the candling line. All eggs are sized before they reach the candlers. In the second system, an egg washer and a drier are incorporated into the candling line, so that all eggs are cleaned and dried before they reach the candlers.

Belt Conveyor System F

Belt conveyor system F is a combination candling, sizing, and tabulating system which includes a mechanical egg sizer and an electrically operated tabulator in addition to the candling and cartoning equipment. The tabulator keeps a count of the total number of eggs handled and prints the count of each grade of eggs on the producer ticket prepared by the truck driver. Basically this system is a conveyor belt system to which has been added a mechanical sizer and a tabulator the use of which permits the candler to devote more time to the candling and cartoning operations, since the occasional checking of egg sizes and the keeping of "case count" records for each grade of eggs are time-consuming jobs when manually performed. The introduction of mechanical equipment provides a high degree of work simplification for the candler and results in a considerable increase

in production per worker by eliminating the need for candlers to size eggs and keep records by use of pencil and paper. Empty cartons are supplied to the candlers by a separate worker. This worker supplies six chutes in front of each candling work station with cartons from a catwalk located above the work stations (fig. 20). The carton makeup machine is mounted on a platform from which it feeds cartons onto a conveyor belt that runs parallel to the catwalk, from which empty cartons are placed into the chutes.

Figure 20.--Filling carton chutes from elevated catwalk.

A layout of the system showing the various work stations is shown in figure 21. This layout is an installation for eight candlers (fig. 22). For maximum efficiency the manufacturer recommended that this equipment should be installed in batteries of not less than four or five stations. The reason for this recommendation is that one worker can supply uncandled eggs to that number of candling stations. Each candling station has a sizing machine and a loading bench on the opposite side of the candling bench. Unit loads of producers' eggs are brought to the loading bench located parallel to the sizing machine (fig. 23). The loading bench consists of short gravity roller conveyor sections that hold four cases. The case handler transfers cases from the unit loads onto the roller conveyors at all loading stations. The loaders, by use of transfer trays, lift 72 eggs at a time from the cases and transfer them onto the spool conveyor of the sizing machine. Empty flats and fillers are placed in suitable racks at the loader work station.

The spool conveyor transfers the eggs to a belt conveyor which moves them to the scale baskets. The sizing machine automatically segregates the eggs into four weight classifications--large, medium, small, and peewee (fig. 24). As eggs leave the sizer they are conveyed to a candler's tray which is separated into four sections to accommodate the four different grades. The speed of feeding and sizing can be adjusted to the skill of the individual candler. A switch at the candler's station and another at the loading station permits either worker to stop the system, if necessary.

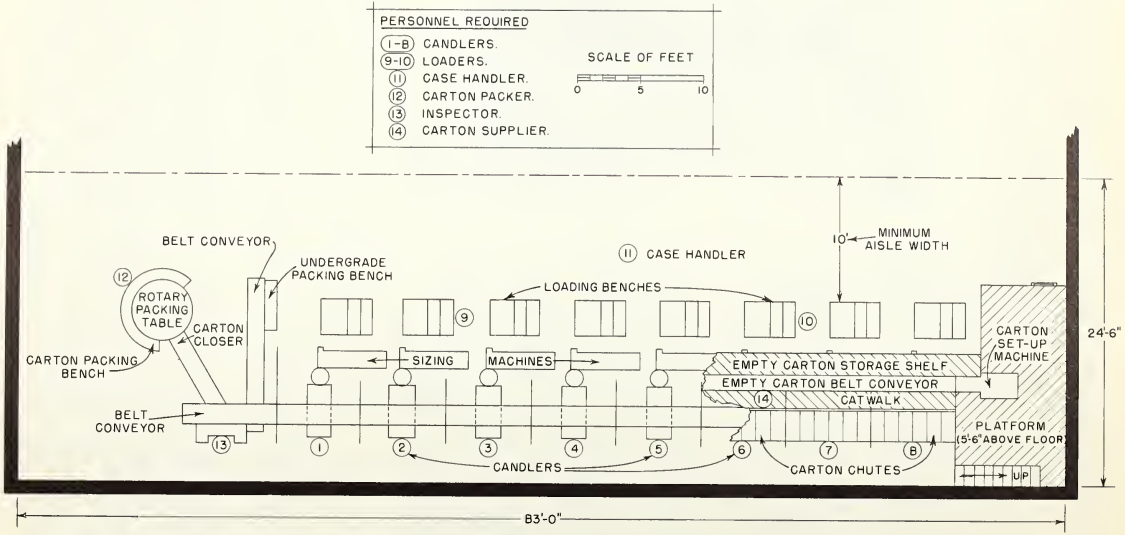

Figure 21.--Layout of belt conveyor system F.

Figure 22.--Work stations for eight candlers. (Note position of carton chutes.)

Figure 23.--Loader transferring two trays of eggs (72 eggs) from producer cases to spool conveyor on sizer.

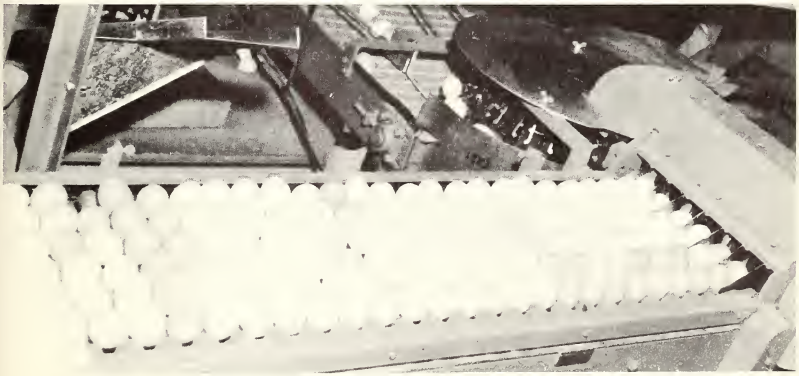

Figure 24.--Egg sizer showing spool conveyor with sizing mechanism at far right and graded eggs being transported to candler.

The eggs are candled and placed in the appropriate cartons. A continuous supply of cartons is supplied to each work station by means of six chutes located within arm's reach above the candling light. (See fig. 22.) Top grades usually are packed in cartons, and undergrades are placed in flats and fillers supported on racks directly under the carton chutes. When filled, the flats are pushed onto a belt conveyor which transports them to the packing area (fig. 25). Full cartons are pushed onto a second belt conveyor directly underneath the belt used for flats. Full cartons and fillers are automatically counted as they are pushed onto the respective conveyors. At the end of each producer lot, the odd numbers of eggs falling in each grade are recorded by means of telephone-type circular dials located along the conveyor belts. These dials operate the tabulator which prints the count of each grade of eggs on the producer ticket originally attached to the lot by the truck driver. These tickets provide the office records which determine the payment for the eggs to the producer on a grade basis.

Figure 25.--Packing area, showing undergrades being packed at far left, carton eggs in center, and sealing cases at far right.

Candler, Washer, and Drier

Dirty eggs are a problem for all egg assembly plant operators. Light dirty eggs sometimes are cleaned by use of a mechanical buffer or an egg-cleaning brush during the candling operation. However, in some areas where there are large volumes of dirty eggs, the use of some type of mechanical cleaner operating on a production-line basis is necessary. It is recognized that methods used for cleaning eggs is a highly controversial subject, and the description of cleaning equipment which follows is not a recommendation of any specific method.

The combination candler, washer, and drier combines a mechanical washing and drying unit with a conveyor belt which transports eggs to the candlers (fig. 26). Each washer has a conveyor belt capable of accommodating a total of six candlers, three on each side of the belt (fig. 27). Eggs are removed from the belt, candled, and placed in the appropriate case on the work bench. When full, cases are stacked behind the candlers and removed to the cooler by a case handler.

The washing and drying unit is at one end of the candling conveyor belt and requires one operator to remove the eggs from cases and place them in the washer (fig. 28). The washing operation is automatic and

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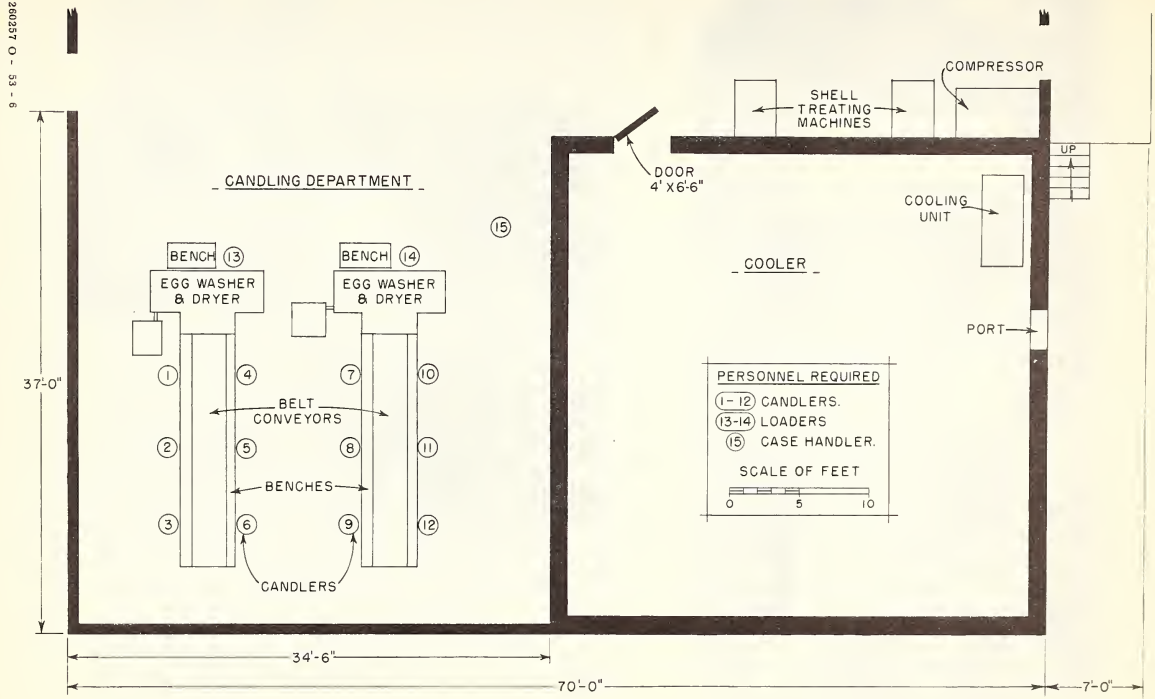

Figure 26.--Layout of candler, washer, and drier system.

Figure 27.--Candling bench used in conjunction with washer and drier.

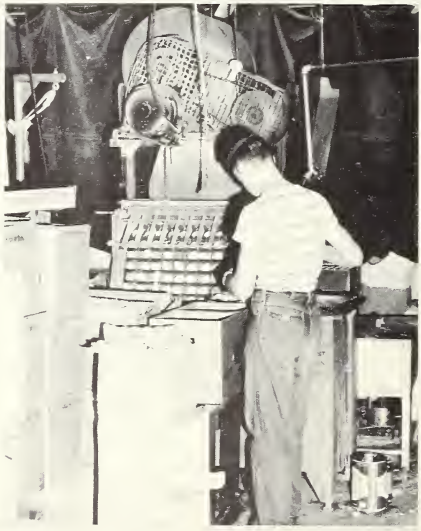

Figure 28.--Loader transferring eggs from cases to washer.

eggs are dried as they are removed from the washer before they are deposited on the conveyor belt. To keep the candling operation semi-dark, a dark curtain is suspended from the ceiling between the washer and the candling conveyor belt. When it is unnecessary to wash certain producers' lots of eggs the eggs bypass the washer and are moved directly to the candling work stations.

By use of this system, when eggs also are oil-treated, but in a work area away from the candling and washing area, the handling of egg cases from one area to the other and the rehandling of all flats and fillers in each case is necessary. The possibility of combining these operations should be considered by the addition of an oil-treating unit to the washer-candling line. An oil-treating unit which combines these operations is shown in figure 29. The washer, drier, and candling belt are similar to the system previously described. The entire section at the left in the figure contains the oil processing equipment. The complete unit eliminates much unnecessary handling and increases the productivity of the workers.

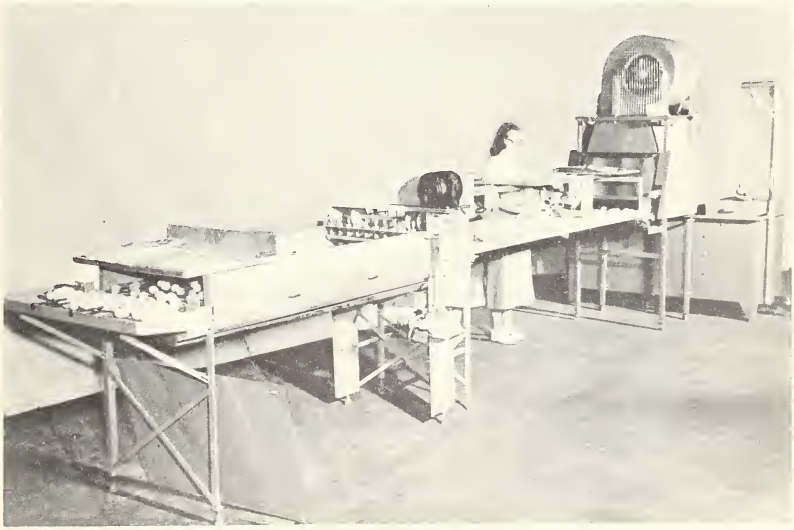

Figure 29.--Egg washer, drier, candler, and shell-treating machine.

Summary of Floor-Space Requirements

The comparative space requirements for each of the belt conveyor candling and cartoning systems previously described is shown in table 1. This table is presented as a guide in comparing the space requirements for the various cartoning and candling systems. The selection of any particular system is dependent not only on the physical limitations of a particular layout but also on the buying practices and grading systems in use. All dimensions are considered to be the minimum necessary for installation and include necessary work space at each work station. Work aisle widths are based on the assumption that a "unit load" method of handling will be utilized in all cases. It is recognized that some candling and cartoning equipment installations can probably be made in smaller areas than those indicated; however, it is suggested that individual installation requirements be determined by representatives of the equipment manufacturer.

Table 1.--Comparative space requirements for specified candling and cartoning systems designed for 10 candlers

Candling and cartoning system	Candling area					Packing area							Total candling and packing area (Columns 6 + 13)
	Candling bench length	Candling bench width	Work aisle width	Total work station width	Total candling area	Equipment length 1/	Work aisle length	Total work station length	Equipment width 1/	Work aisle width	Total work station width	Total packing area	
	Ft.	Ft.	Ft.	Ft.	Sq.ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Sq. ft.	Sq. ft.
A	43.33	4.33	12.00	16.33	708	9.00	4.00	13.00	17.50	8.00	25.50	332	1,040
B	2/ 21.67	4.33	3/ 10.00	14.33	311	9.00	6.00	15.00	10.00	8.00	18.00	270	581
C	2/ 26.25	3/ 17.00	9.00	26.00	683	9.00	10.00	19.00	15.00	11.00	26.00	494	1,177
D	2/ 22.50	5.67	6.00	11.67	262	4/ 14.00	12.00	26.00	10.00	10.00	20.00	520	782
E	2/ 30.00	4.50	8.00	12.50	375	16.00	8.00	24.00	14.00	7.00	21.00	504	879
F	66.67	5/ 11.50	13.00	24.50	1,633	6/ 21.50	8.00	29.50	14.00	24.50	38.50	1,135	2,768

1/ Includes carton closer, carton setup machine, packing table, packing bench, and conveyor pulley unit.
2/ Candling stations on both sides of bench.
3/ Includes gravity conveyor to move cases to and from work stations.
4/ Includes belt conveyor loading bench.
5/ Includes loading benches and sizers.
6/ Includes platform for carton setup machine.

PRINCIPLES OF MATERIALS HANDLING

Egg assembly plant operators and handlers who wish to make the most efficient use of their present equipment should familiarize themselves with materials-handling principles and seek ways of applying these principles to their own operations. If the plant foreman and workers responsible for unloading, stacking, candling, and loading out eggs understand and apply these principles, substantial reductions in handling costs should be possible.

Balanced Handling

One of the factors contributing most to the relatively high costs of handling eggs and related supplies 4/ is a lack of balance in handling operations. To perform an operation efficiently, a balanced crew and equipment are of utmost importance since, in most instances, the accomplishments, or productive work performed, of one crew member depends on the work accomplished by another crew member. Thus, if there are too few workers employed in one phase of an operation, considerable time may be lost by other workers waiting for another phase of the task, thereby increasing the costs of the entire operation.

Definition of Balanced Handling

Balanced handling is defined as the arrangement and assignment of members of work crews and equipment in accordance with the minimum number of workers required and the arrangement of their work in the operation so that delay time and total labor requirements are minimized.

Importance of Balance in Unloading Operations

In one poorly balanced operation observed, a crew of 7 workers was used to load 500 cases of eggs on a motortruck by means of four-wheel hand trucks. These workers were assigned as follows:

Crew assignment	Number of men
Unloading cases of eggs from cooler	2
Transporting cases of eggs by four-wheel hand trucks from cooler to motortruck	3
Stowing in motortruck	2
Total	7

4/ Supplies include shook, flats, fillers, empty cases, and cartons.

A study of this operation revealed an unbalanced method because the workers were idle a considerable part of the time. The transporters had to wait for the handlers, at each end of their trips, to complete assigned work before they could work productively. By decreasing the number of workers from 7 to 5, and assigning them as shown below, the productivity of the 5-man crew equaled that of the original 7 men (fig. 30):

Crew assignment	Handling crew No. of men	Transporting crew No. of men	Total No. of men
Unloading cases of eggs from cooler	1	1	2
Transporting cases of eggs from cooler to motortruck by four-wheel hand truck. .		1	1
Stowing cases of eggs in motortruck.	1	1	2
Total.	2	3	5

The elapsed time required by the 7-man crew to breakout of storage, transport, and load 500 cases on the motortruck was 50 minutes. The total labor required was 5.83 man-hours. The same elapsed time (in minutes) was required by use of the 5-man crew, because the 2 men who were idle were eliminated, but total labor requirements were reduced to 4.16 man-hours or a reduction of 28.65 percent.

The key to the improvement lies in the assignment of workers transporting the cases to assist in loading and unloading the hand trucks. The number of workers required for transporting will vary with the distance traveled between the cooler and the motortruck.

Perfect balancing of all operations is not to be expected. Some idle time through unavoidable delays, crew interferences, and other wait time usually can be expected when crews consist of two or more workers. To eliminate the "burdening" of some workers, it may be desirable, depending on skills required, for all crew members to perform all the tasks at one time or another during the operation. This shifting of workers serves to familiarize the men with the various operations and possible difficulties which are encountered. The result will be a work crew which can be interchanged with little or no time lost by workers familiarizing themselves with the work.

Unbalanced operations always result in a bottleneck. Idle crewmen, waiting for handling equipment, are positive evidence that the work load is not properly distributed throughout the operation.

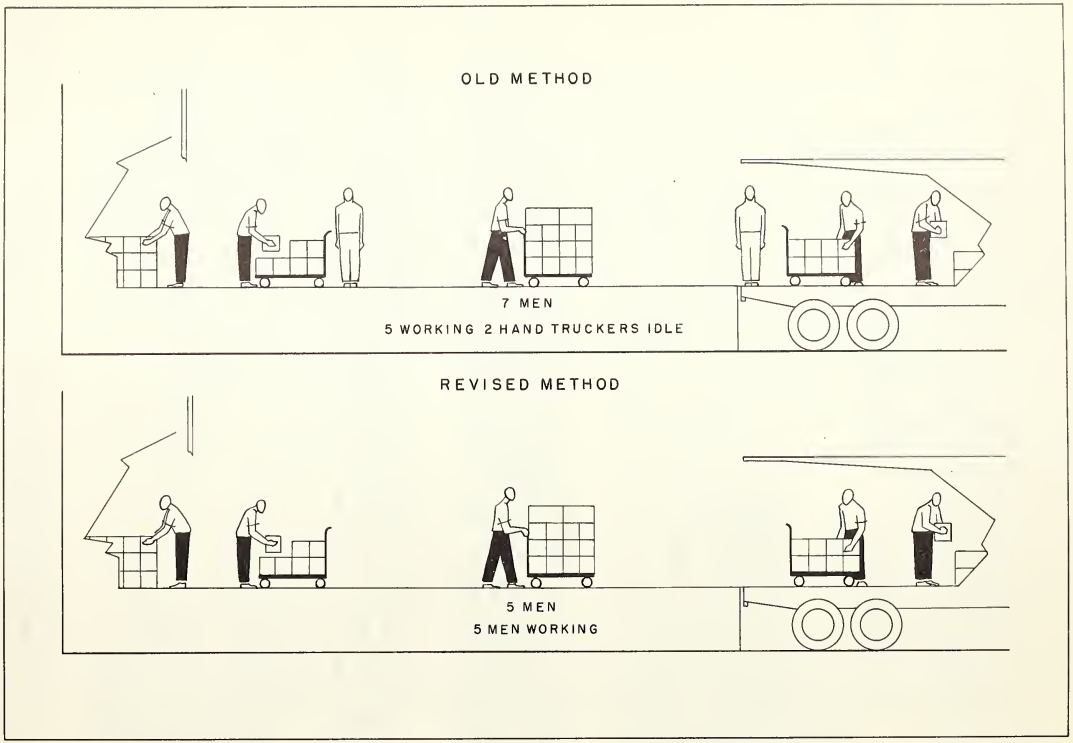

Figure 30.--Illustration of an unbalanced and a balanced work crew.

Moreover, it is possible in any situation for the bottleneck to shift from one part of the operation to another as the work progresses. An example of how the bottleneck may shift can be shown in connection with the hand stacking of loads above shoulder height. A worker ordinarily can maintain a fast, steady pace in stacking, as long as he does not lift packages higher than his shoulder. However, when packages must be lifted overhead, the stacking pace invariably drops sharply. It is possible that when operations in the receiving cycle are performed in sequence and when egg cases are piled 6 high, a bottleneck will form at the stacking area unless additional workers are assigned to stacking or fewer workers perform other operations in the cycle.

Egg assembly plant operators should periodically check their handling operations for bottlenecks and balance out crew sizes and equipment for lower handling costs. When two or more men are engaged as a crew in handling eggs or related supplies, the work should be synchronized so that all members of the crew will do productive work. Crew arrangements in which some crew members wait for other crew members to complete part of the work before they can do their own work, should be avoided.

Unit Loads

Although the unit-load principle of materials handling is well known and widely used in industrial and commercial warehousing operations, it is not in common usage in the egg and poultry industry. However, handling in unit loads is on the increase among members of this industry.

Definition of Unit Load

A unit load is made up of several packages grouped together so that they may be handled as a unit for unloading, transporting, stacking, or loading operations, or through any combination of these operations, rather than as individual packages. A unit load usually is considered to be a loaded pallet or skid, but might well be any load consisting of two or more packages which are so set together that they can be handled and moved simultaneously or as a unit.

Importance of the Unit Load

The effect of the unit-load principle on labor requirements for handling of eggs and related supplies can be illustrated by a comparison of an operation performed by use of two-wheel hand trucks, without applying the unit-load principle, and an operation performed by use of semi-live skids in which the unit-load principle is applied. The effectiveness of the use of unit loads in reducing labor requirements can be brought out through an example of unloading, transporting, and stacking a truckload consisting of 500 cases of eggs.

Two-wheel hand trucks--without unit loads. The use of ordinary, stevedore-type two-wheel hand trucks does not permit the handling of cases of eggs in unit loads because these cases must be removed from tightly packed stacks in a truck, usually 6 cases high, and restacked to an equal height in the cooler room. Normally, the sequence of operations would be as follows:

1. Load four cases onto hand truck.

2. Transport four cases to the cooler.

3. Unload cases one by one and stack in cooler.

The above steps are illustrated in the upper section of figure 31. To unload and place the 500 cases of eggs in the cooler there are 500 handlings of the individual cases in the truck, 125 round trips (4 cases per trip) between the truck and the cooler, and 500 rehandlings of the individual cases in the cooler.

Semi-live skids--with unit loads. Although there are possibilities for handling unit loads by use of some types of two-wheel hand trucks, one of the lower-cost types of equipment by use of which unit loads can be handled is the semi-live skid and hand jack. Dollies, and dead skids handled by use of hand lift trucks, also can be used for unit-load handling. (See the section on "Some Improved Methods of Handling Shell Eggs and Related Supplies" for descriptions of these types of equipment.)

When semi-live skids are used, the basic steps in the application of the unit-load principle in unloading the 500 cases of eggs are:

1. Wheel empty skids into motortruck and place cases of eggs, one at a time, onto the skid, 24 cases to a skid load.

2. Wheel the loaded skid, a unit load, to the cooler by use of hand jack.

3. Position the loaded skid in the cooler and remove the jack.

These steps are illustrated in the lower section of figure 31. In this operation, the 500 cases of eggs are handled individually during the unloading of the truck; 21 trips (24 cases per trip) are made to the cooler, and 21 skid or unit loads are positioned in the cooler. Cases of eggs are not off-loaded from the skids. Only 21 round trips are made to the motortruck and the storage point instead of 125 trips when hand trucks are used, and only 21 skid loads are deposited in the cooler as units. No rehandling of individual cases is necessary.

Advantages of the unit load. Some of the advantages of handling cases of eggs and other materials in unit loads are:

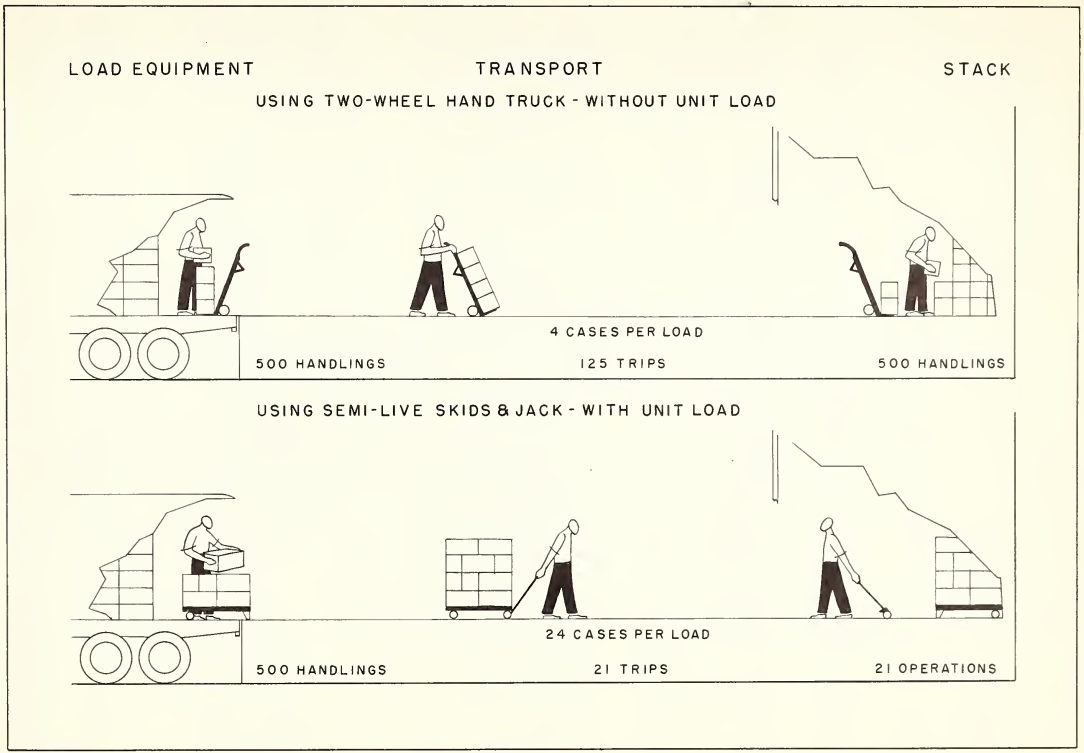

Figure 31.--Two methods of unloading a truckload of 500 cases of eggs.

1. Unit loads reduce the number of times cases of eggs and related supplies are handled individually.

2. By the use of certain types of equipment, larger unit loads can be handled and the number of trips required to move a given number of cases of eggs can be reduced.

3. Unit loads simplify the taking of inventory, since the number of cases in the unit gives the stock on hand.

4. Because of the reduced number of handlings, the amount of breakage and deterioration resulting from picking up and dropping individual cases usually is reduced.

Once the unit load is assembled, savings are brought about because a number of cases are handled at one time as a unit rather than individually. Unit loads should be maintained until it is essential for them to be broken up, as at the candling bench or in the motortruck, when loading out. The longer the unit load can be kept intact for all handlings, the greater the savings in handling costs.

Mechanical Equipment

Most egg assembly plant operators have several types of handling equipment, some of which was purchased for specialized operations. Nevertheless, cases of eggs still are manually handled, even in some of the most modern plants, because a number of plant operators consider manual handling to be the most efficient method for certain selected tasks. In selecting equipment, plant managers should give careful consideration to the handling job to be done, the potential performance of certain types of equipment in the facilities occupied, and the work load.

Definition of the Mechanical-Equipment Principle

Efficiency and economy in handling eggs and related packaging materials are obtained by using mechanical equipment in place of manpower wherever practicable. This principle means simply, that the use of hand trucks, conveyors, skids, pallets, and hand lift and industrial trucks results in more efficient and economical handling than when manpower is used. The type, or combination of equipment types, needed is dependent on the volume handled and the physical plant facilities.

Importance of Applying Mechanical-Equipment Principle

The use of mechanical equipment is more economical than the use of purely manual labor when savings in direct labor costs are greater than the costs of owning and operating the equipment. However, before buying new handling equipment, plant operators should make sure that present equipment is being used as efficiently as possible. Sometimes costs may be reduced

by using improved methods, with the equipment in use, to such extent that the additional savings possible with new equipment would not be large enough to pay for the amortization of new equipment in a reasonable time.

Although most physical handling operations can be performed by use of mechanical equipment with fewer workers, in less elapsed time than that required for purely manual handling, it is sometimes true that, because of the small volume to be handled, the purchase of mechanical equipment could not be justified and the handling cost would be increased if mechanical equipment were used.

Where new equipment is needed, the simplest types or combinations of types of materials-handling equipment applicable to the job should be selected. As a general rule, special or custom-built equipment should be avoided since it usually is more expensive and must be adapted to the handling situations with more experimentation than the readily available types. Moreover, maintenance problems may be increased because special parts may not be readily available as required.

In most egg assembly plants several types of mechanical equipment are required for the various handling operations. Equipment should be purchased for the savings it can make in labor, supervision, and other operating costs for performing a stipulated amount of work. The decision with respect to the types to be purchased should not be based on first cost alone. Unfortunately, there is a tendency in many plants to add equipment of the type already in use, without considering types that might be more suitable. The cash outlay for equipment may be relatively small at the outset, but the purchase of more expensive and newer types of equipment, capable of doing a more efficient job as volume continues to increase, might prove more economical over a period of time.

Only a few egg assembly plant operators maintain records of materials-handling costs that might be used as a basis for determining possible savings through the purchase and use of new handling equipment. However, estimates can be made by using the following procedure:

1. Compute the annual labor costs for handling eggs and related supplies with current methods and types of equipment, noting the elapsed time required for handling a truckload or carload through the various cycles or groups of materials-handling operations, and multiplying this figure by the hourly wage rate of each employee. The sum will give the cost for each carload or truckload. These figures should then be multiplied by the estimated number of truckloads or carloads handled during the year to determine total annual labor costs. There must be added to these labor costs the ownership and operating costs of the equipment used. The sum of these costs represents the cost of handling by present methods.

2. Estimate the elapsed time required for handling a truckload or carload through the various cycles of operations by use of contemplated

new equipment. Multiply the numbers of workers to be employed in various cycles of operations by the elapsed time, to determine total labor requirements in terms of man-hours per truckload or carload. Compute direct labor costs by applying proper wage rates. Multiply the total by the number of equivalent truckloads or carloads of eggs and related supplies to be handled during the year to arrive at the total annual labor cost for performing these operations with proposed equipment. Since equipment costs are involved, the costs of ownership and operation of the equipment must be added to direct labor costs to arrive at a basis for making comparisons with current costs.

3. Subtract the total of item 2, above, from item 1. The difference constitutes the estimated annual savings that the new equipment should make possible.

When estimated savings are small, it may not be desirable to purchase new equipment unless there are other compensating advantages--such as safer working conditions, better utilization of floor space, fewer damaged goods, and reductions in the elapsed time for performing operations--because the cost estimates developed may be subject to some margin of error.

Materials Flow

When eggs and related supplies are moved as directly or through the shortest possible distance between two points in a plant, the elapsed time required and the costs incurred for performing materials-handling operations are reduced.

A plant layout incorporating wide aisles, easy turns, platforms of adequate widths and heights, and ample approaches to doorways of adequate size, permitting two units of materials-handling equipment to pass, increases the productivity of mobile materials-handling equipment by permitting increased speed, a smoother and more direct flow of work, less congestion, and safer working conditions. At the same time a properly arranged plant reduces interference with the materials-handling activity among the several units of equipment operating within the plant.

The route of travel should be as short and direct as possible. Out-of-line hauls and back hauls should be avoided. Smooth floors, with all areas of the assembly plant on the same level, facilitate flow of the work in the plant.

Instruction of Employees on the Use of Equipment

The results obtained with materials-handling equipment are directly dependent on the familiarity of the worker with its use and application. Unless the equipment is properly operated, the maximum possible savings will not be obtained. Labor should be instructed in the proper use of equipment to reduce accidents, to reduce damage to the eggs, and to preserve the equipment itself.

When an item of equipment, particularly one that requires a large investment, is out for repairs, the cost of repairs may be a minor item compared with the greater monetary loss incurred as a result of the hours of time the equipment is withheld from productive work and the additional stress that is put on other equipment.

Workers should be periodically instructed on handling methods and operating procedures. New employees should not be given an item of equipment and permitted to learn how to use it by themselves. To obtain the best results, plant managers should instruct new employees in the proper use of the equipment. Workers also should be instructed in the use of new methods. They should be encouraged to suggest improved methods.

Instructions on the proper use of materials-handling equipment should:

1. Reduce the labor requirements.

2. Minimize the severity and frequency of accidents with resultant savings in compensation.

3. Improve the handling and stacking of eggs and packaging materials.

4. Reduce damage and repairs to materials-handling equipment.

5. Reduce the amount of breakage and other damage to the eggs.

Review of Operations

A thorough review of materials-handling methods at regular intervals is essential to the maintenance of maximum operating efficiency.

Changes in plant layouts may make original methods obsolete, and the development of new methods and equipment makes it essential that management continually review present handling methods and check their costs to obtain the best results from the work being done.

As part of this review, management should not lose sight of the fact that the cost of handling eggs and related supplies should decrease as the quantity handled increases until the capacity of the materials-handling equipment has been reached. Overloading equipment is not conducive to economical operation. Therefore, methods that hold promise for better utilizing equipment should be fully explored. However, before buying new materials-handling equipment, management should make certain that the present equipment is being used as effectively as possible. The objective of every plant manager should be to eliminate as much handling as possible and to hold to a minimum rehandlings, congestion, and delays in the course of the work.

Preventive Maintenance

The productivity of materials-handling equipment is increased when repairs are anticipated and worn parts are replaced so as to prevent interruption of materials-handling operations.

As the term implies, preventive maintenance consists of proper care, including lubrication, to keep the equipment mechanically fit so that breakdowns or failures may be minimized. Regular inspection to anticipate repairs, as well as cleaning, oiling, adjusting, and making necessary repairs before wear and damage becomes serious, should reduce costly breakdowns or equipment failures and make it possible to obtain maximum results from use of the equipment. Lack of lubrication and the failure to make necessary repairs, when first warnings of difficulties are noticed, are the major causes for equipment breakdown. When breakdowns occur, more cumbersome and costly methods for carrying on the work must be resorted to until the equipment can be repaired and brought back into service.

Although preventive maintenance applies particularly to industrial trucks, tractors, conveyor systems, and other powered equipment, it also should apply to two-wheel hand trucks, four-wheel hand trucks, skids, hand-lift trucks, industrial trailers, and other manually operated equipment. For the latter types of equipment, preventive maintenance should encompass regular lubrication to minimize the physical effort required of workers, to prolong the life of the equipment, and to reduce the cost of repairs.

Preventive maintenance and repair work should not be left to the workers who use the equipment. These responsibilities should be assigned to one individual who should see that equipment is checked and lubricated at the beginning of each shift, or weekly, monthly, and semiannually, as required for the various components of the equipment. Equipment manufacturers or their sales representatives will provide charts showing the points requiring lubrication, the type of lubricants required, and the desired frequency of lubrication. Manuals that show the parts of the equipment needing daily, weekly, monthly, and semiannual checking usually are available.

Depending on local conditions, mechanical equipment periodically should be given a general overhauling which should consist of disassembling all major items of the equipment and replacing worn parts. If not available locally, spare parts should be stocked so that repairs can be made on short notice and the equipment placed back in operation in a minimum period of time. The equipment manufacturer can suggest spare parts that are most likely to be needed on short notice.

Before a new piece of mechanical equipment is put into service, the manufacturer's serviceman should be called in to instruct the operator in the proper use and operation of the equipment. He should also confer with the individual responsible for maintenance and give him information relative to the maintenance of the equipment.

Preventive maintenance also is concerned with overloading equipment, which may result in serious and time-consuming breakdowns. Floors should be kept clean and in good condition. Holes and separations in the flooring slow down operations and require more physical effort when using hand equipment and more power for mechanical equipment. They also place a strain on the equipment.

A preventive maintenance program should:

1. Reduce total maintenance costs.

2. Prolong or increase the useful life of equipment.

3. Reduce the total amount of equipment required in plants that use a number of similar units.

SOME IMPROVED METHODS OF HANDLING SHELL EGGS AND RELATED SUPPLIES

Generally, too little attention is given to materials-handling methods and equipment used in egg assembly plants. In many instances, plants have expanded operations and volumes handled but have failed to obtain adequate handling equipment to minimize handling costs and improve over-all efficiency. Too frequently, as volumes have increased, additional equipment of the type already in use have been added to meet requirements without adequate consideration of other types of equipment.

However, a number of plant operators have developed and are using improved handling methods. Some of these methods involve the use of equipment that may not be familiar to some plant operators. However, the new equipment and improved methods have in most cases reduced handling costs and made the work easier. Some of these methods which appear to have wide applicability are described in the sections that follow.

Modified Egg Case Truck

The two-wheel hand truck is the type of materials-handling equipment most widely used in egg assembly plants. These hand trucks, which are referred to as "egg case trucks," usually are designed to handle wooden cases which have cleated ends. The increased use of fiberboard cases, without cleats, has limited the extent to which egg case trucks can be used. However, these trucks can be adapted to the handling of fiberboard cases in unit loads, by the use of attachments which readily can be added to or removed from the hand truck.

As shown in figure 32, two separate attachments are necessary. The lower of these attachments consists of a set of forks which is used, in connection with a pallet, to pick up and support the bottom case in a stack. The other attachment consists of parallel arms which stabilize the top case in the stack. These attachments are made of 1/4- or 3/8-inch flat iron, 2 or 2½ inches wide, welded together to form the forks, and similar material is bent and welded to 1/2-inch rods to form the arms. The rods on the arm attachment slide into short pieces of pipe clamped to the inside of the handles. The fork attachment hooks over a brace used on all egg case trucks. These attachments are used in conjunction with a single faced 1- by 2-foot pallet. The pallet is constructed of 1- by 4-inch lumber held together by cleats of sufficient height to permit the forks to slide underneath the entire pallet load. When used with the special pallet, the fork attachment slips underneath the stack and supports the entire load and the upper attachment braces the top case in the stack and keeps it from falling onto the handles. This attachment permits the size of the unit load handled to be increased from three cases, usually handled, to four cases. The loading of the fourth or top case onto the stack results in a 33-percent increase in the load carried per trip and a 25-percent decrease in the number of trips necessary to move a given number of cases.

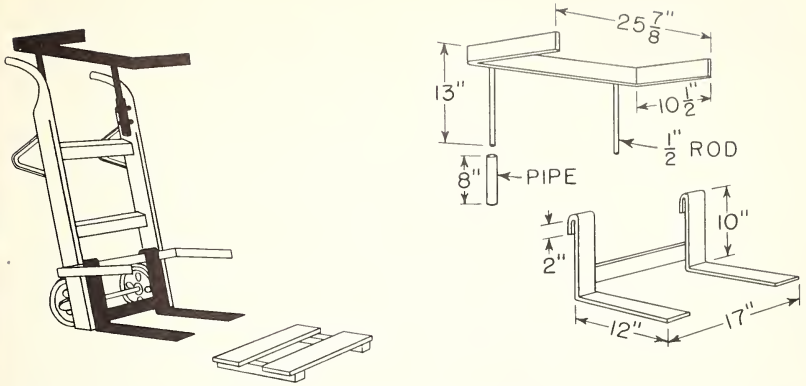

Figure 32.--Suggested attachments for handling fiberboard cases on egg-case trucks.

Pallets provide support for 4-case high stacks and keep the bottom case of each stack off the refrigerator floor. This clearance minimizes case damage resulting from excessive moisture. These attachments permit the transportation of eight 15-dozen cases in one stack or unit load. Only a minimum delay in handling operations is necessary for removing the attachments when changing from the handling of fiberboard to wooden cases.

Four-Wheel Hand Trucks

Of the plants in which observations were made, 32 percent used four-wheel hand trucks for certain handling operations. Considerable variation was observed in the use of this equipment in the plants. Generally, four-wheel hand trucks are used in conjunction with conveyors.

The four-wheel hand truck consists of a wooden platform, approximately 2 by 4 feet, mounted on four wheels, two of which are fixed and two are of the swivel type (fig. 33). These trucks usually have a capacity of from 16 to 20 cases of eggs. One end of the truck has a bar hand rail, which can be used for pushing or pulling the load. This handle can be removed easily by lifting it out of the sockets which hold it in position.

When four-wheel hand trucks are used for unloading route trucks at egg plants lacking unloading platform facilities the cases of eggs are manually moved to the tailgate of the motortruck or trailer, or gravity conveyors are used. The cases are then stacked on the hand truck. The loaded hand truck is then pushed to the storage or hold point where the

Figure 33.--Four-wheel hand truck loaded with 16 cases of eggs.

Figure 34.--Loading motortruck by use of gravity conveyor and four-wheel hand truck.

cases are manually removed and stacked. This truck is also used in handling operations within the plants, for example, to transfer eggs between the coolers and the candling room, and to handle supplies to and from the storage area.

The four-wheel hand truck is used also in loading motortrucks, particularly when the motortruck loading point is some distance from the storage area. To perform the loading operation the egg cases are placed on the hand truck at the cooler or hold point and the loaded hand truck is then pushed to the tailgate of the motortruck (fig. 34). The cases are then off loaded directly into the motortruck manually or by use of a gravity conveyor and stowed.

An advantage is that one man by use of the four-wheel hand truck can move a relatively large number of cases--16 to 20 full cases or more than 20 empty cases--at one time. These hand trucks are highly flexible in that they may be used over any route in the plant or for moving practically all types of cases, materials, and supplies generally found in egg assembly plants. Also, they are used for temporary storage of cases of eggs or supplies.

The use of the four-wheel hand truck requires the rehandling of individual cases, in both loading and unloading the hand trucks. To obtain optimum use of equipment and storage space it is necessary to off load the four-wheel hand trucks at the storage point. One rehandling is eliminated if the unit-load principle is practiced and the load is left intact on the equipment. Unfortunately, this practice is not generally recommended.

Dollies

The dolly is a platform, or an open frame made of steel or wood, equipped with four casters, two are fixed and two are of the swivel type. Since loads carried seldom exceed a thousand pounds, the platform is of a light type of construction. A common size is 2 feet wide, 4 feet long, and approximately 6 inches high. The dollies are either purchased from suppliers or made out of wood or angle iron and suitable casters. Some dollies which are equipped with the swivel casters have eyes or rings to which suitable hooks can be attached to pull the loaded dollies about the plant. (See fig. 36.)

Some plant operators utilize four-wheel dollies as a unit-load system for handling egg cases and supplies. Several patterns of loading are used in assembly plants, as shown in figures 35 and 36, and the unit load is maintained throughout as many handlings as is possible. For example, the dolly is loaded, it is then moved to the storage area, and the loaded dolly is left there until needed. This practice eliminates two handlings, the off loading and the reloading. Any relocation of the load within the storage area can be accomplished with a minimum of time and labor.

When dollies are used to hold unit loads in storage the need for loading and unloading materials is eliminated. Dollies are of light construction and

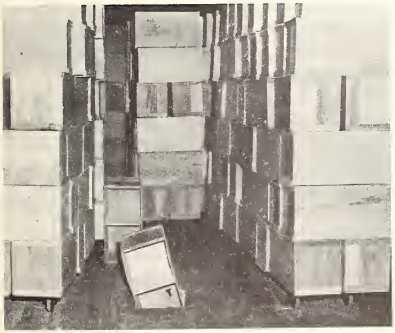

Figure 35.--Dollies loaded with 30 empty cases. (Note trap door in floor which opens into a chute serving the loading platform.)

Figure 36.--Dolly loaded with 20 cases of eggs. The dolly on end in foreground shows method of construction. (Note eye used for towing.)

are relatively inexpensive. Many plant operators find that the use of dollies for handling operations in the plant, in place of more expensive equipment, decreases the cost of unit-handling.

When not in use, dollies are stored in a small area by stacking one on the other as shown in figure 37, or by leaning them against each other along a wall.

Figure 37.--Dollies with angle iron frames nested on top of each other.

The use of the dolly is limited to the load it is designed to carry. Light construction coupled with small diameter wheels decreases the stability of heavy loads. This may cause loads to be upset with consequent damage to the load. Control of the movement of the dolly is difficult to maintain, when not using a hook, because the pressure is applied to the load rather than to the dolly itself. Loads may be upset by sudden stops or turns, or by travel over rough floors.

Skid Systems

Skid systems permit the application of the unit-load principle and help to improve handling efficiency. The use of the skid method accomplishes two basically important results: (1) Once the material is piled on a skid, the load can be moved from one place to another, and into cars or trucks without rehandling individual packages; and (2) in comparison with hand trucking, the load is larger. Under good conditions, 500 pounds would be close to the maximum hand-trucking load, and 150 feet per minute would be close to the maximum speed. With the use of skids, a load of one ton is not uncommon; however, a load of 20 to 24 egg cases is generally transported on this equipment. The speed of travel with manually propelled equipment is comparable to that obtained with hand-truck methods; however, with motorized equipment the speed is 3 to 5 times as fast.

Semi-Live Skid and Jack

The semi-live skid and jack is a relatively simple and inexpensive type of equipment which employs the unit-load principle (fig. 38). The semi-live skid consists of a load-carrying platform with two rigid wheels at one end and two skid legs at the other end. The platform is usually from 30 to 36 inches wide, and from 48 to 60 inches long. The skid jack is a lever-type handle equipped with two wheels mounted on an axle which

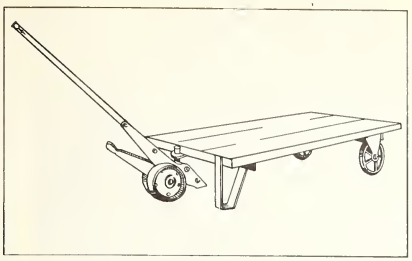

Figure 38.--The semi-live skid and jack.

fits into a coupling on the leg end of the skid. When the handle is lowered to approximately 30° the legs are raised off of the floor and the entire load is made mobile for transportation.

Of the egg assembly plants visited only a few of the larger plants used semi-live skids and jacks. In order to utilize this equipment to best advantage it is preferable to have the unloading platform or plant floor at truck-bed level so that the equipment can be brought into the truck. This permits the loading of skids with egg cases or supplies in the truck and transporting to the proper holding or storage areas. These skids can then be moved, as a unit, at any future time, without the rehandling of the individual cases which they carry. One plant unloads all of its incoming eggs by use of skids at the unloading platform and then transports them to the refrigerated cooler where they are left until needed in the candling room. Skid loads of eggs (20 cases) are transported to the candling room and transferred to the candling bench as needed. The empty skid is then reloaded with cases of candled eggs and returned to the cooler where it is held until a full truckload accumulates (fig. 39). When loading operations begin, individual skid loads are removed from the cooler and transported to the stowing point inside the motortruck. This is continued until the truck loading is completed. This method of handling requires 5 skids to transport 100 cases, or only 25 skids for 500 cases--the equivalent to an average truck trailer load.

Dead Skids and Platform Low-Lift Truck

Another type of skid system is the dead skid which is used in conjunction with platform lift trucks. These skids are made of wood or metal, or a combination of the two, and are supported by steel legs or runners, 8 to 12 inches high. A hand-lift truck, manually propelled and incorporating a mechanical or hydraulic pressure system, is used for lifting the skid load (fig. 40). The lifting is accomplished by exerting downward pressure on the handle or by pumping the handle up and down several times until the skid supports are clear of the floor. In lowering the skid a release lever on the handle or a foot pedal regulates the release of the load. The principle of this handling method is to keep materials off the floor and to reduce the number of handlings. The skid loads are transported from one operation to another with little effort and in a relatively short time. A recommended ratio of skids to low-lift hand platform trucks is considered to be 25 skids to one truck.

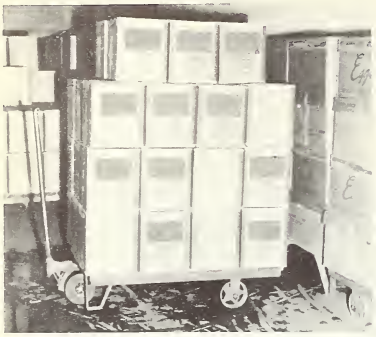

Figure 39.--Unit load of egg cases on semi-live skid in cooler ready for loading.

Figure 40.--Low-lift hand platform truck and dead skids. (Note stacks of empty skids in background.)

Low-lift platform trucks were used in only a few of the larger egg assembly plants visited. In all these plants the egg cases are stacked on skids in the motortruck as they are received and are then transported to appropriate work areas. In some instances skid loads of eggs are moved direct to refrigerated areas for temporary holding. As eggs are needed in the candling room they are withdrawn, one skid at a time, from the refrigerator, thereby minimizing the time that eggs are exposed to the higher working room temperatures (fig. 41).

Some egg assembly plants which carton eggs and pack them in 15-dozen cases utilize the low-lift hand platform truck and dead skids. The skids are located at the packing table and loaded with cases after they are filled. The number of skids required depends on the number of grades of eggs being packed and the production rate of the candling line. After the skids are loaded they are transported to a holding room or cooler (fig. 42). When motortruck loading operations begin the skids are again transported to the loading platform and into the truck, where the cases are removed from the skids and stowed.

Appraisal of Skid Systems

A desirable feature of the skid system of handling is its high degree of versatility. Skids lend themselves to construction of racks, shelves, boxes, and other suitable accessories which facilitate handling operations. The skid also permits the stacking of irregularly shaped objects which project over the edges of the skid itself. This is particularly helpful when used for knocked-down cases and packing materials which are longer or

Figure 41.--Transporting egg cases with low-lift hand platform truck. (Note stacking arrangement in last two rows of cases to prevent top cases from toppling off.)

Figure 42.--Cartoned eggs in 15-dozen cases on a dead skid.

wider than the supporting skid. Scales, box-staplers, and other production equipment can be mounted on skids so that they can be readily moved from place to place within the plant.

Perhaps the greatest advantage lies in the reduction of the number of handlings of individual packages such as eggs and other materials moved through the plant. This is particularly true where loading areas are at truck-bed level and the equipment is taken directly into the truck. It is then possible to introduce the unit-load principle at the very first stage in the plant's operations and the unit load is maintained as the product moves from one operation to the next. With proper stacking, one man by the use of skids can transport 20 to 24 cases. By placing the skids at the appropriate work stations each worker stacks the cases directly on the skid after completing his operation. This decreases the number of individual handlings which are required when less efficient methods are used.

The generally accepted policy is to provide one low-lift hand platform truck or jack for each 15 to 25 skids or semi-live skids. This proportion varies depending on the particular facility and the operations performed. Preliminary estimates 5/ indicate that the low-lift-hand-platform-and-dead-skid method is slightly more economical than other methods

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5/ An Analysis of Some Methods of Loading Out Delivery Trucks of Produce Wholesalers. Marketing Research Report No. 15. USDA-PMA. May 1952.

from the standpoint of initial cost and operation. Additional economies can result if dead skids are built by the plant operator with idle labor and available materials.

Loading and unloading platforms of the proper height are essential for the most efficient utilization of the skid systems of handling. Unfortunately, many egg assembly plants do not have platforms; they operate at ground level. The direct movement of skids into transportation equipment is precluded. However, this does not prevent the use of skid systems for intraplant handling operations.

The improper storage of empty skids reduces the amount of available floor space. The amount of space required for skid storage can be minimized by proper stacking, as illustrated in figure 43. For semi-live skids, which are generally heavier, it is possible to stack (fig. 44) or to lean one skid against another along a wall.

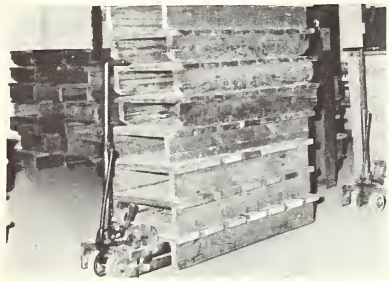

Figure 43.--Homemade wooden dead skids stacked at receiving area.

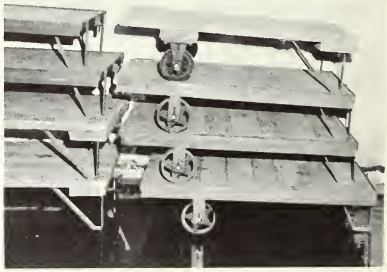

Figure 44.--Semi-live skids stacked near receiving area.

Comparison of Transport Time With the Use of Different Types of Mobile Equipment

The various types of mobile handling equipment and methods which have been described were found in progressive egg assembly plants of various types and sizes. One of the principal uses of mobile types of materials-handling equipment is for transporting materials between various points within a plant during the normal sequence of plant operations. The comparison of the elapsed times required to transport within the plant an average trailer truck load of 500 cases of eggs by use of different methods, shown in figure 45, should provide a better understanding of the improved methods. The time requirements were based on time studies of handling methods under actual operating conditions. These comparisons

METHODS	CASES PER LOAD (NUMBER)	ROUND TRIP (200 FEET) (MINUTES)	LOADS (NUMBER)	TOTAL TIME (HOURS)
	1	.58	500	4.83
	4	.65	125	1.35
	20	.77	25	0.32
	24	.75	21	0.27
	24	.53	21	0.18

Figure 45.--Comparative elapsed times required to transport 500 cases of eggs a distance of 100 feet by use of various methods.

should be used primarily as a guide in determining the type of equipment which each manager can use under his particular conditions. 6/

Chutes

Some between floor handling operations, at some plants, are performed by the use of chutes for conveying full or empty cases or supplies. These chutes are made of steel rods, wood, or sheet metal. They are sometimes designed so that the speed of movement of the material in the chute is under control. Improper design may result in damage to full and empty cases or in injury to employees.

At one plant an effective method of loading motortrucks with empty cases by use of a chute was possible, because empty cases were stored on a second-story level directly above the loading area. The chute is made

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6/ Some operators are handling shell eggs with pallets and fork-lift trucks. This method is under study and will be covered in a subsequent report.

of 3/8-inch steel rods, extending from an opening in the second-story floor to the point over the truck loading platform. The chute is hinged at a point near the ceiling over the platform so that it can be raised out of the way when not in use (fig. 46). An extension used with the chute terminates in the truck. This extension is constructed of the same material as the chute and is easily moved to a convenient storage point when not in use. In using this equipment one man on the second-floor storage area feeds empty cases into the chute, which conveys them to two loaders inside the truck (fig. 47).

Chutes are also used to convey flats, fillers, cartons, and other supplies between floors to the candling room or other work areas. One man in the storage area by use of chutes can deliver to the work areas a full day's supply of materials in a relatively short time.

Although chutes are used very effectively in moving materials by gravity, they do not have any degree of flexibility because of their fixed locations. The construction of the chutes themselves, especially poor designs or improper slopes, may result in damage to packages. Unless the speed of packages, particularly eggs in cases, is controlled, there is the possibility that some damage will occur when cases hit each other at the bottom of the chute. The lack of proper stops may result in damage caused by cases falling off at the base of the chute. Except for those chutes which can be raised out of the way when not in use, many chutes take up space which could be utilized for other purposes.

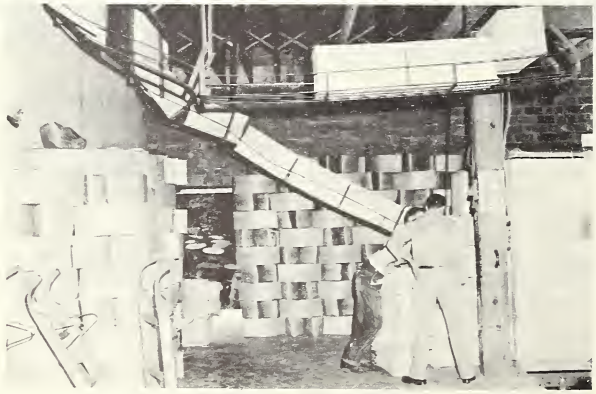

Figure 46.--Chutes extending from empty case storage area to loading dock. (Note raised chute and chute being used for loading in background.)

Figure 60.--Opening portable folding-type belt conveyor.

Figure 61.--Loading motortruck by use of portable folding-type belt conveyor.

which receives its wooden knocked-down cases by rail, stores these materials on the second floor. This plant has no elevator and all supplies are moved to the upper story by means of a belt conveyor (fig. 62). The conveyor is rolled onto the loading platform and elevated so that one end is inside the railroad car and the other is inside the building on the second floor. A control switch on both ends permits a crew member at either end to shut off the power and stop the conveyor, when necessary.

Figure 62.--Wooden egg case materials being moved directly from railroad car to second-story level by use of a portable belt conveyor.

The use of belt conveyors in combination with gravity conveyors is common in plants where the belt conveyors are found. The belt conveyor is utilized to overcome differences in elevation and sections of gravity conveyors are used to reach stockpiles or perhaps extend into transportation equipment. This permits a continuous loading or unloading operation from the platform to the stockpile. Such a system is illustrated in figures 63 and 64.

At this plant, the cases of eggs are stored on skids in a refrigerated room in the basement. In loading out, the skid loads are moved to and placed at the basement

Figure 63.--Cases of eggs being moved from basement to loading dock by use of a permanent-type belt conveyor.

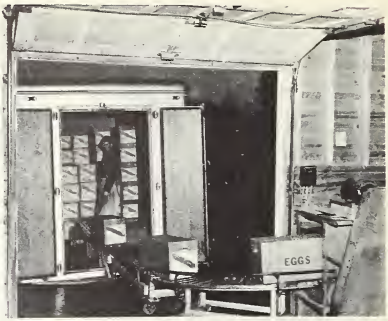

Figure 64.--Gravity conveyors extending from belt conveyor across platform into truck.

end of the permanent belt conveyor and each case of eggs is manually transferred to the belt by one worker. The cases are carried by the conveyor to the first floor where they are moved onto a curved section of gravity roller conveyor. This conveyor in turn is connected with suitable straight sections of gravity conveyors extending to the stowing point in the truck. By use of this method, which utilizes a two-man crew in the basement and a two-man crew in the truck, 450 cases of eggs can be loaded into a motortruck in an elapsed time of approximately 26 minutes not including setup time. Since the gravity conveyors on the platform are on casters they are moved into position easily and very little setup time is required.

Another plant utilizes portable belt, gravity, and flexible conveyors for loading-out operations. This plant does not have a loading platform and the loading-out door is located only a short distance from the egg cooler. Since this door is used for other operations it is necessary to use a portable belt conveyor to bridge the gap from the cooler to the truck. A small port was constructed in the cooler so as to permit the conveyor to project inside and at the same time minimize the loss of cool air during the loading operation. The egg cases inside the cooler are transported to the belt conveyor by use of flexible gravity conveyors which can be expanded to reach any point in the cooler (fig. 65). The belt conveyor elevates the egg cases to the truck-bed level and deposits them on sections of gravity conveyor extending inside the motortruck (fig. 66). This method of loading utilizes a three-man crew--one worker in the egg cooler to place cases of eggs on the flexible conveyor and two men to stow the cases in the truck. All types of egg cases--either 15- or 30-dozen capacity--can be loaded or unloaded by use of this method.

Figure 65.--Transporting egg cases in cooler to belt conveyor by use of a flexible-type conveyor.

Figure 66.--Belt conveyor elevating egg cases to truck-bed level and depositing them on gravity conveyors inside motortruck.

Conveyors perform elevating operations mechanically and therefore reduce the amount of lifting required by work crews. Where belt and gravity conveyors are combined, it is possible to eliminate transport labor which is common to other handling methods. The combined use of belt and gravity conveyors requires smaller work crews, and permits faster loading and unloading with less lifting and rehandling. The reduction in the number of manual handlings of individual cases of eggs minimizes the opportunity for damage and breakage.

The use of belt conveyors in some plants increases the effective utilization of their over-all facilities by permitting more extensive use of basements and upper stories. The portable belt conveyors also permit better utilization of floor space by allowing higher stacking of supplies where floor loads permit. Portable conveyors are especially useful where work crews are small; for example, two men--one at the stockpile and the other inside the motortruck--can carry on loading and unloading operations, provided, the work areas are properly located within the plant itself. Conveyors can be used to handle increased volumes merely by adding more workers to the operating crew.

Portable belt conveyors can be moved and placed into position by one man so that work crews need not be delayed during the setup. One man can set up the equipment for shipments which are expected, with a minimum of delay and interference with other personnel. When incoming motortrucks are unloaded and then reloaded, without leaving the platform, it is possible, by making a few adjustments in the stands supporting the gravity conveyors, to perform the loading operation with only a slight delay.

The power unit for belt conveyors requires oiling and periodic inspection for proper maintenance. Care must be exercised not to overload the motor and the belt must be kept under proper tension.

In some plants where floor space is extremely limited the storage of a portable conveyor when not in use presents a problem. If floors are rough, particularly wooden floors, it is difficult to move the portable conveyor from one plant area to another.

HANDLING AIDS AND INNOVATIONS

Auxiliary Mobile Candling Bench

Some plants that candle a relatively large number of grades simultaneously do not have sufficient space on the regular candling bench for both the graded eggs and the rejects. To overcome the shortage of bench space, one plant manager constructed mobile benches which were placed at right angles to the regular bench between each candling station (fig. 67). The mobile benches, which are mounted on casters, are large enough to hold two cases, or roughly 12 by 52 inches. Generally, these benches are used for rejects. Since the benches are movable they can be removed and stored when not needed or not in use. Mobile benches can be added to any number of regular benches if and when candling requirements necessitate their use.

Figure 67.--Mobile benches on either side of candlers along regular candling bench.

Collapsible Stand for Spot Candling

In one egg assembly plant a collapsible stand for use in spot checking cases of eggs as they are unloaded from route trucks was found to be a time saver. This stand is located near the receiving area so that the eggs from any producer, especially new accounts, can be checked for quality (fig. 68). As cases of eggs are unloaded from the route truck they are moved to the candler at the collapsible stand where a quick check is made of the eggs received. The collapsible stand eliminates the necessity for transporting cases of eggs to the regular candling room and then moving to storage. When not in use the stand is collapsed in a flat position against the wall so that it does not interfere with handling operations (fig. 69). As shown in this illustration, an egg scale and a hook are kept at the spot candling station. The hook is used to drag stacks of empty cases from the stockpiles to the trucks.

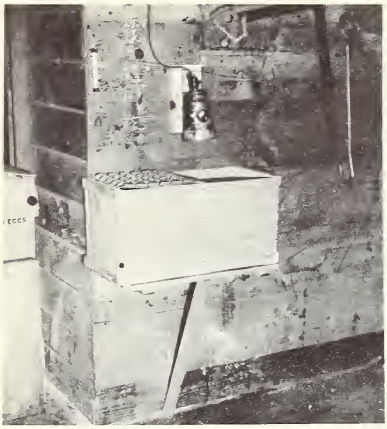

Figure 68.--Stand for candling in open position.

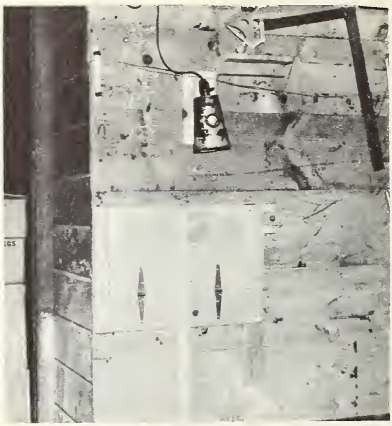

Figure 69.--Stand for candling in collapsed position.

Gravity Conveyors to Transport Eggs from Receiving Area to Candling Department

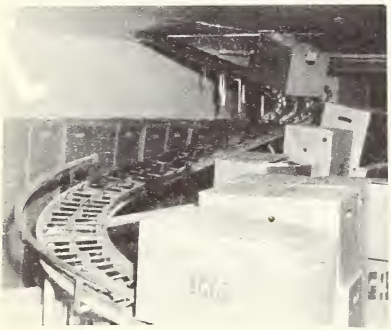

Figure 70.--Gravity conveyor used to transport eggs from the receiving area on the first floor to the basement.

A number of egg assembly plants operate in multistory buildings, usually at two-floor levels (first floor and basement), and have elevators that are slow and of limited capacity. To overcome the bottleneck in moving eggs on an elevator from the receiving department on the first floor to the candling room in the basement, one plant manager installed a curved gravity conveyor (fig. 70). This conveyor originates at the receiving area near the office, passes through an opening in the floor, and terminates at a convenient stacking point in the candling room. By use of this type of conveyor, it is possible for the clerk in the

office to receive eggs from producers and move them immediately to the cool basement. In addition to the saving in labor, the conveyor system also helps the plant to maintain the interior quality of the eggs.

Internal Plant Communications

A wide variety of communication systems are available to egg assembly plants for use in locating of personnel and for minimizing idle and wait time in the performance of various operations and in shifting from one job to another. 7/ Several plants have intercommunication systems with speakers located at key points throughout the building. For example, speakers can be located at the plant foreman's work station and at the loading platform, over which the plant operator can convey messages to the foreman or work crews without a great deal of wasted walking time. Where departments are widely scattered or on different floor levels an "intercom" system saves valuable time.

Driveway Signal

At some plants that receive eggs directly from producers, truck arrivals bringing in receipts usually are scattered throughout the day. As a consequence, it frequently is necessary for office workers to locate and notify some of the plant workers to help in unloading the eggs and supplying empty cases. To minimize the interruption of office work and the delay in making workers available for unloading operations, some plants have installed driveway signals. These signals usually consist of rubber air hoses installed in the driveways similar to those used in many gas stations. As the producer's auto or truck passes over the hose a bell or buzzer rings to notify the unloader that he is needed. Office work is not disturbed and the producer is given better and quicker service through the use of this signal.

Mechanical Buffer for Cleaning Eggs

Dry cleaning of light dirty eggs is accomplished at the candling work stations of a number of plants by use of some type of brush covered with an abrasive material. At some seasons of the year, particularly in certain areas of the country, the large number of dirty eggs eggs slows down the candler's production. One plant uses electric motors having buffing wheels coated with abrasive material at the candlers' work stations to clean eggs. These motors are mounted near

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7/ Today's Communication Equipment. J. W. St. Andre. Factory Management and Maintenance. Vol. 109, No. 9. Sept. 1951.

the candling light so that the candler can conveniently reach over and buff any dirty eggs quickly. Each motor has its own switch so that it can be turned on or off for different lots of eggs. Where there are numerous dirty eggs these buffers are operated continuously.

Gummed Tape Dispenser

Figure 71.--Gummed tape dispenser.

One of the most widely used methods of sealing fiberboard egg cartons is the use of gummed tape. Several types of tape dispensers are used in egg assembly plants to expedite the sealing of egg cases at the packing bench. One of these dispensers is shown in figure 71. This model is operated by manually pulling a handle. Some models are operated by use of an electric motor. In both instances the moistoned tape is dispensed ready for application. Selector adjustments permit the machines to dispense the length of tape desired. The machines are relatively small and can be located in a convenient position at the packing work stations thereby minimizing the time required in sealing all types of fiberboard egg cases.

Storage Rack for Empty Producer-owned Cases

In some plants that receive relatively large volumes of eggs in producer-owned cases, the temporary storage of such cases may require a large amount of floor space. In addition, considerable time usually is required in locating individual producer's cases when they are called for. This problem is being solved in some plants by use of a homemade wooden rack with appropriate shelves for storing empty cases. This rack permits the adoption of a systematic arrangement for holding cases so that they can be located with a minimum amount of time and effort.

Figure 60.--Opening portable folding-type belt conveyor.

Figure 61.--Loading motortruck by use of portable folding-type belt conveyor.

which receives its wooden knocked-down cases by rail, stores these materials on the second floor. This plant has no elevator and all supplies are moved to the upper story by means of a belt conveyor (fig. 62). The conveyor is rolled onto the loading platform and elevated so that one end is inside the railroad car and the other is inside the building on the second floor. A control switch on both ends permits a crew member at either end to shut off the power and stop the conveyor, when necessary.

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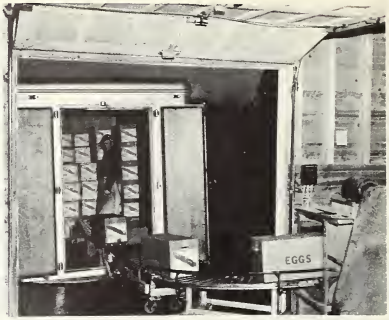

Figure 64.--Gravity conveyors extending from belt conveyor across platform into truck.

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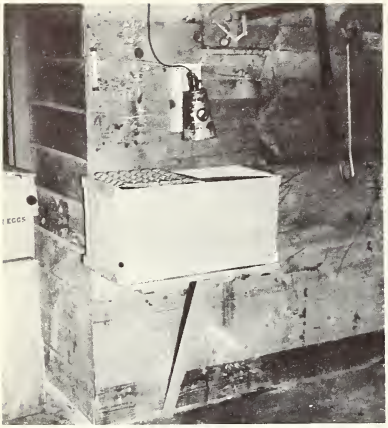

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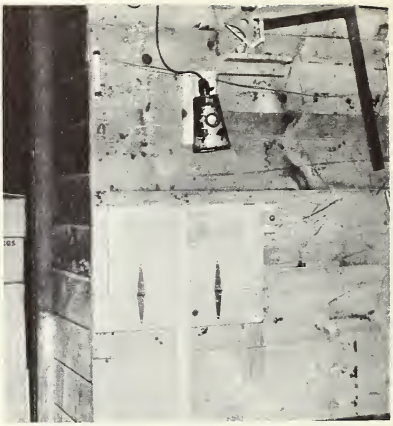

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At some plants that receive eggs directly from producers, truck arrivals bringing in receipts usually are scattered throughout the day. As a consequence, it frequently is necessary for office workers to locate and notify some of the plant workers to help in unloading the eggs and supplying empty cases. To minimize the interruption of office work and the delay in making workers available for unloading operations, some plants have installed driveway signals. These signals usually consist of rubber air hoses installed in the driveways similar to those used in many gas stations. As the producer's auto or truck passes over the hose a bell or buzzer rings to notify the unloader that he is needed. Office work is not disturbed and the producer is given better and quicker service through the use of this signal.

Mechanical Buffer for Cleaning Eggs

Dry cleaning of light dirty eggs is accomplished at the candling work stations of a number of plants by use of some type of brush covered with an abrasive material. At some seasons of the year, particularly in certain areas of the country, the large number of dirty eggs eggs slows down the candler's production. One plant uses electric motors having buffing wheels coated with abrasive material at the candlers' work stations to clean eggs. These motors are mounted near

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7/ Today's Communication Equipment. J. W. St. Andre. Factory Management and Maintenance. Vol. 109, No. 9. Sept. 1951.

the candling light so that the candler can conveniently reach over and buff any dirty eggs quickly. Each motor has its own switch so that it can be turned on or off for different lots of eggs. Where there are numerous dirty eggs these buffers are operated continuously.

Gummed Tape Dispenser

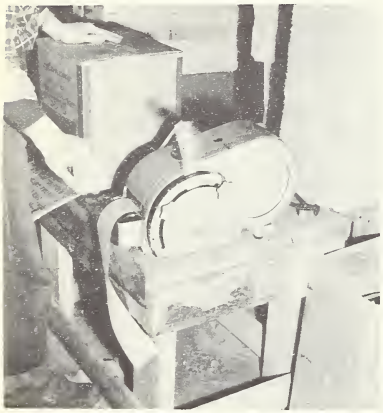

Figure 71.--Gummed tape dispenser.

One of the most widely used methods of sealing fiberboard egg cartons is the use of gummed tape. Several types of tape dispensers are used in egg assembly plants to expedite the sealing of egg cases at the packing bench. One of these dispensers is shown in figure 71. This model is operated by manually pulling a handle. Some models are operated by use of an electric motor. In both instances the moistoned tape is dispensed ready for application. Selector adjustments permit the machines to dispense the length of tape desired. The machines are relatively small and can be located in a convenient position at the packing work stations thereby minimizing the time required in sealing all types of fiberboard egg cases.

Storage Rack for Empty Producer-owned Cases

In some plants that receive relatively large volumes of eggs in producer-owned cases, the temporary storage of such cases may require a large amount of floor space. In addition, considerable time usually is required in locating individual producer's cases when they are called for. This problem is being solved in some plants by use of a homemade wooden rack with appropriate shelves for storing empty cases. This rack permits the adoption of a systematic arrangement for holding cases so that they can be located with a minimum amount of time and effort.

Fiberboard Case Sealer and Stapler

Figure 72.--Portable stapler for sealing fiberboard cases.

Sealing egg cases is accomplished in a number of ways depending on plant conditions, types of cases, and personal preferences. A method used in some plants makes use of a stapling machine that uses a self-closing staple which can be applied from the outside of the case (fig. 72). The stapler is portable, requires very little space, and, if necessary, can be used alongside a candling-room production line. It also can be used at the packing bench in plants that use a packing bench and table for cartoned eggs. The stapling machine is lightweight and can be operated either by men or women who work in the packing area.

Wooden Case Hammer Stapler

Figure 73.--Stapler for nailing wooden cases.

The amount of labor required for nailing lids on wooden cases is relatively high in plants that use wooden cases extensively. Furthermore, some type of nailing bench or worktable is required for holding cases, lids, nails, hammers, or hatchets used in the nailing operation. The hammer stapler shown in figure 73 has its own supply of staples and permits the lidding operation to be conducted with sufficient speed so that it can be incorporated into a production line. In the illustration, the nailer's work station is a gravity conveyor which transports the cases of eggs from the packing table to the storage room. By placing this work station along the conveyor line, a large number of case handlings is eliminated and the time required for this nailing operation is reduced as much as 50 percent.

Portal for Producer Egg Deliveries

Figure 74.--Portal with self-closing doors for producer egg deliveries.

At some egg assembly plants producers deliver directly to the plant 25 percent or more of the plant's total receipts. These deliveries are either in full cases or parts of cases. To facilitate the handling of producer deliveries, some plants have small receiving portals, with double swinging doors, next to the sidewalk or driveway (fig. 74). The door is conveniently located above ground level to minimize lifting and carrying. A gravity conveyor (usually 10 feet long) extends from the portal to a convenient point inside the plant, which eliminates the necessity for plant workers going outside to receive small lots of eggs. Use of portals for receiving small lots of eggs facilitates checking and recording of deliveries and provides the producer with an appropriate record of the ungraded eggs.

Auxiliary Door with Loading Portal

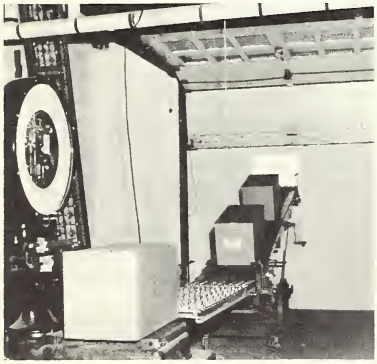

Figure 75.--Auxiliary plywood door in position showing portal and equipment for handling egg cases.

A number of plants have large wide doors of the overhead type which must be kept open during lengthy loading or unloading operations in which conveyor systems are used. During cold weather these large open doorways permit the loss of heat, create drafts, and contribute to the general discomfort of workers in the area. To minimize the size of the opening, one plant operator fabricated an auxiliary door from a plywood panel in which was cut a small portal to accommodate conveyor equipment (fig. 75). The doorway is fitted with a standard 8-foot overhead-type garage door. When motortrucks arrive for unloading the door is partially raised, the auxiliary door is inserted, and the conveyor

is placed in position. Where relatively large volumes are handled, a small door might be made for the portal to minimize the effort in positioning the larger plywood panel. However, the auxiliary door is light in weight and can be handled easily by one worker. When not in use this door is placed out of the way along the wall.

Truck-Loading Portals in Cooler Rooms

In some remodeled egg assembly plants cooler rooms have been installed so that the doors are not readily accessible to the area used for loading and unloading motortrucks. As a consequence these handling operations are not efficient. In some plants it has been possible to construct portals in the refrigerator wall (figs. 76 and 77). These portals permit direct loading into trucks from the stockpiles in the refrigerator. Care should be exercised in planning a portal to see that its height above street level is low enough to accommodate small trucks and high enough to accommodate the higher trailer trucks.

Figure 76.--Loading portal in refrigerator wall with belt and gravity conveyors.

Figure 77.--Outside view of loading portal.

Loading Pattern Measuring Stick

There is a considerable variation in the size of motortruck bodies used for transporting eggs. Plant operators usually do not know in advance exactly what size truck body will be sent to pick up loads. On many occasions there is a considerable delay on the part of the loading crew while the foreman or the driver determines the

loading pattern in the truck. One plant foreman speeds up the determination of the loading pattern by use of a 2" x 2" graduated stick five cases long. By use of this stick it is possible to measure the inside of any truck and quickly determine the loading pattern to be followed.

Automatic Door Control

The maintenance of low temperatures in air-conditioned rooms and refrigerators is very important in conserving egg quality. In order to minimize the loss of cool air caused by frequent opening of doors, some plants have installed automatic door openers and closers. This equipment can be installed so as to be controlled manually, mechanically, or electronically. All of these controlling mechanisms can be located so that the operator of materials-handling equipment can pass through the doors without any delays.

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